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MODEL NMG-115-10 & NMG-115-12

GENERATOR SET

SERVICE AND PARTS MANUAL

MANUFACTURED BY KLINGE CORPORATION

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MARATHON LIMA MAC SERVICE MANUAL

Serial Numbers Registration – Warrantee

The blue data plate machine serial number and the ISO container serial number should be reported to engineering@klingecorp.com at the time of installation. In the event that the installation date and which machine is on which container is not reported, the warrantee period will default to 18 months from the date of manufacture. Failure to report the above could result in the warrantee period being foreshortened.

Use of this Manual

By extension, this manual may be used for other combinations of the same equipment but one would be better served by reference to the particular model, items, and variations. The model number on all Klinge Corporation equipment may be found on the blue serial number data plate. With the model number you may pull down and print out the whole or relevant sections of the manual from the www.klingecorp.com /manuals download/ then model number. If the particular model is not on the web page contact **engineering@klingecorp.com** or telephone **(USA) (1) 717 840 4500**.

The use of this manual is intended for the safe operation of the equipment described. It is therefore reasoned that persons who have the occasion to use this manual have a knowledge of mechanical and electrical systems and components addressed by its' contents. However, efforts have been made to enable persons less familiar with these systems to use this manual.

Suggestions as to improvement in content and format are welcome and should be addressed to engineering@klingecorp.com . Corrections and improvements will be included on dated revisions - the latest of which will be available on the web page.

PRE-TRIP CHECKOUT FORM

1. Inspect generator set for damage, missing parts, or loose mounting bolts.

2. Check fuel level. Use ASTM D975-96 #2-D or #1-D in cold weather;
   DIN EN 590; BS 2869; NATO Code F-54 / F-34 / F-44 and XF 63 or equivalents.

3. Inspect fuel sediment bowl for water or contaminants. Loosen plug to drain bowl.
   Unscrew bowl, after disconnecting heater plug, to rinse out if dirty.

4. Check engine oil level. Add oil to dipstick mark if needed. Use MULTIGRADE SAE 10W-40 API rating CC/CD or higher and SAE 5W-20 when operating at temperatures below -4° (-20°C) or equivalents.

5. Check that NO MORE THAN 250 HOURS or ONE YEAR since oil has been changed has passed.

6. Inspect air filter restriction indicator. Replace filter if necessary or clean it to remove the dust by blowing, only from inside, compressed air at 45 to 75 PSI (3 to 5 kg/cm^2).

7. Check fan belt for wear, cracks and proper tension. Tighten or replace if needed

8. Make sure that fan is not damaged and that cooling air circulation is not obstructed. Clean the radiator with compressed air if necessary.

9. Check that coolant level in radiator and in overflow bottle is to the full line. Add 50/50 water/ethylene glycol mixture if necessary.
   Warning: ”DO NOT OPEN RADIATOR CAP WHEN ENGINE IS HOT”.

10. Check for frayed battery cables, cracked wire insulation and for clean and secure electrical connections. Clean or replace as needed.

11. Make sure that the Refrigeration Unit Power Plug is correctly inserted into the Power Receptacle and that the Auxiliary Battery Charging System is connected.

12. Energize glow plugs for 5 to 7 seconds and check if Ammeter needle is deflected in the minus area to make sure that the glow plugs are energized.

13. Switch the ON-OFF switch to “ON” and start the generator set.
    Wait until Voltmeter reads correct voltage (should be in the green band area).
    Check oil pressure gauge. Reading should be minimum 30 PSI.
    Observe Ammeter to insure that battery is charged.

14. Turn “ON” the generator Load Switch and afterwards start the Refrigeration Unit.

15. Check engine air and cooling hoses and fuel lines. Tighten or replace any component where leaks appear. Observe exhaust, if exhaust is dirty stop engine and check air filter.

16. Observe and record HOURMETER reading at top of form.

SECTION ONE

SPECIFICATIONS

GENERAL

The NMG-115-10 (Nose Mount Generator Set) was specifically designed to meet the rigorous demands of ocean, over-the-road, and rail transport of 20' and 40' refrigerated containers. The NMG-115-10 can be mounted quickly in the nose of a container, using only four bolts.

CONSTRUCTION

Welded aluminum frame
Aluminum doors and closures
Stainless steel hardware

ENGINE

ISUZU 4LE2PV liquid cooled Diesel.
Four Cylinder; 2.2L; 4 Stroke; Direct Injected; Naturally Aspired; Glow plug Assisted Start.
37.6 BHP (28.0 kW) @ 1800 RPM Rated Output / 32.1BHP (23.9 kW) @ 1800 RPM Cont.

ALTERNATOR

15 kW / 18.75 kVA MARATHON ELECTRIC - LIMA MAC REEFER, specifically designed for starting 3 phase AC electrical motors.
Single bearing, 10 Lead, 1800 RPM, Y 480 / 240 Volts, 0.8 Power Factor lagging.
Class F-Stator / H-Rotor Insulation , 104°F / 40°C Ambient, 10 Leads, Self-Excited and Inherently Regulated providing 4% voltage regulation without external Voltage Regulator or Transformers, with automatic Volts / Hertz operation capability.
The Air Intake is labyrinth baffled to minimizes particle and moisture penetration.
NOTE: The output voltage is not adjustable but is directly related to the engine's speed. Normal readings at 1800 RPM (60 Hz) are between 460 and 500 V.

TEMPERATURE OPERATING RANGE

From -20^{o} F to +125^{o} F (-30^{o} C to +50^{o}C)

WEIGHT

- 1315 lbs (596 kg) without fuel
- 1665 lbs (755 kg) with full fuel tank

MOUNTING

Mounting clip in back, 4 bolts in front

FUEL SUPPLY

The Generator Set has an incorporated Fuel Tank with a capacity of 50 US gallons (190 L) that can provide around of 50 hours of operation under full load.

POWER SUPPLY

STANDARD: 15 kW - 480 V AC / 3 phase / 60 Hz
25 A Power circuit breaker
CEE 17 - 32 A Power Receptacle
OPTIONAL: 15 – kW 230 VAC / 3 phase / 60 Hz
50A Power Circuit breaker
50 or 60 A Power Receptacle

CONTROLS

- Two toggle switches, ON-OFF and START-PEHEAT
- Low oil pressure switch 1 Pole P > 14 PSI (1 kg/cm^2) OPEN
- High coolant temperature switch 1 Pole < 221°F (105°C) OPEN
- Electronic TIMER Emergency Stop Unit and LED indicators for cause of shut down
- Engine oil pressure and coolant temperature gauges.
- Hour-meter
- Amp-meter for battery charging control
- AC Volt-meter for power output control with green band between 420 and 500 V
- 25 A Circuit Breaker for the DC 12 V system

ELECTRICAL STARTING SYSTEM

- Battery: 12V, Group 31 – 925 CCA @ 0°F (-18°C) with a reserve capacity of 175 minutes.
- Battery Charging Alternator: 20 or 35 A, 14 V DC
- Starter Motor: 2.0 kW, 12V Gear Reduction type
- Glow plug assisted start with control resistor

FUEL SYSTEM

- The fuel system is self-bleeding and self-priming.
- Electrical 12 V fuel supply pump mounted on the engine.
- Large capacity 10 micron Fuel Filter with Water Separator and incorporated 12V-200 W Heater to prevent wax build-up in cold weather.
  The fuel heater is controlled by a thermostat that starts operating at 45°F (7°C) and stops at 75° F (24ºC) as long the electrical control system is “ON”.
- High pressure Bosch / Zexel in line PFR type Injections Pumps controlled by a variable speed < 5% mechanical Governor.
  Each cylinder has its own Injection Pump.

LUBRICATION SYSTEM

- Full pressure system with trochoid type Oil Pump, driven from the crankshaft.
- Oil pan made out pressed stamped steel, full sump, with a capacity of 8.9 U.S. quarts (8.4 liter).
- Full flow, spin-on Oil Filter, replaceable paper element type.

COOLING SYSTEM

- Pressurized liquid (50/50 water / glycol mixture) forced circulation by Centrifugal Pump.
- Thermostat, wax pellet type, opening at 170ºF (76.5ºC).
- Cooling Fan suction type, plastic 6 blades, 15.75” (400mm) diameter
- Heavy duty 4 row, 3 pass copper / brass Radiator.
- High coolant Temperature Switch, normal open, single pole, closing at 221º (105ºC).

COMBUSTION AIR CLEANING SYSTEM

- One high performance single stage Cyclopac® Air Filter with extended life dry Cartridge and automatic dust and water expelling Vacuator™ Valve.
- Air cleaner restriction indicator for maximum filter life.

SECTION TWO

SAFETY PRECAUTIONS

ROTATING HAZARDS

1. Keep your hands, clothing, and tools clear of the alternator belt when the generator set is running.

2. If it is necessary to run the generator with a removed cover, be very careful with tools or meters being used in that area to avoid contacting the rotor.

BATTERY HAZARDS

Few people realize just how dangerous a battery can be.

The electrolyte in a lead acid battery is dilute sulfuric acid (H_2SO_4). During charge or discharge functions of a battery, a chemical change takes place within the individual cells that cause the bubbling we see through the filler hole. This gas bubbling is hydrogen and oxygen, and it is **EXPLOSIVE**. If during this gassing action, a means of ignition is present, an explosion could occur. A defective battery may suddenly explode even while standing idle. Added to this danger, consider a fall-out of highly corrosive sulfuric acid caused by the explosion.

PRECAUTIONS

1. Always wear eye protection when servicing batteries. If electrolyte is splashed on the skin or in the eyes, flush immediately under running water. Obtain medical help as soon as possible.

2. When charging batteries, do not remove the vent caps.

3. When disconnecting or reconnecting the generator-set battery make sure the ON/OFF switch is in the **OFF** position to prevent an arc, which could cause the battery to explode. Disconnect the ground cable first, preferably at a point away from the battery. Reconnect the ground cable last, again away from the battery if possible.

4. **DO NOT** check a battery by "**sparking**" across the posts. Eye injury from the arc or explosion may occur.

ELECTRICAL HAZARDS

HIGH VOLTAGE

When servicing or repairing a generator set, the possibility of serious or even fatal injury from electrical shock exists. Extreme care must be used when working with an operating generator. Lethal voltage potentials can exist on connections that are in the exciter control box.

PRECAUTIONS

1. When working on high voltage circuits on the generator sets, **DO NOT** make any rapid moves. If a tool drops, **DO NOT** grab for it. People do not contact high voltage wires on purpose. It occurs from an unplanned movement.

2. Make sure of your footing. If you slip, you will instinctively grab for support. This can be lethal around a generator set. Work on rubber mats or dry wood if possible.

3. Use tools with insulated handles that are in good condition. Never hold metal tools in your hand if exposed energized conductors are within reach.

4. Treat all wires and connections as high voltage until a meter and wiring diagram show otherwise.

IMMEDIATE ACTION must be initiated after a person has received an electrical shock. Obtain expert medical assistance if available.
Remove immediately the source of shock by either shutting it down or removing the victim from the source. If it is not possible to shut off the generator set, the wire should be cut with an insulated tool (e.g. a wooden handled axe or cable cutters with heavy insulated handles), or a rescuer wearing insulated gloves. Whichever method is used, **DO NOT** look at the wire while it is being cut. The ensuing flash can cause blindness. Remember that insulated gloves **MUST BE** insulated and not just rubber gloves manufactured for protection from liquids. If the victim has to be removed from live circuitry, pull him off with a non-conductible material. Use his coat, a rope, a piece of dry wood or loop your belt around his leg or arm and pull him off. **DO NOT TOUCH THE PERSON**, you could receive a shock from current flowing through his body. After separating the victim from the power source, check immediately for respiration and presence of pulse. If a pulse is present, respiration might be restored by mouth-to-mouth resuscitation.

LOW VOLTAGE

Control circuits utilized by the generator set are low voltage (12 volts D.C.). This voltage potential is not considered dangerous, but the large amount of current available (over 300 amps) can cause severe burns if shorted to ground.
1. Disconnect the negative terminal of the battery if possible when working on the generator set. Disconnect the cable end that is away from the battery.
2. **DO NOT** wear jewelry, watches, or rings. These items can short out and cause severe burns to the wearer.

GENERAL SAFETY PRECAUTIONS

1. Use extreme caution if holes are drilled into the generator set. Holes drilled into an electrical wire can cause fire, explosion, or shock hazard.
2. Be sure all mounting screws are tight and are the correct length.
3. Keep tools and equipment clean and in good working condition. Accidents occur when you attempt procedures without the proper tools.

SAFETY DO'S AND DON'TS

DON'T

DON'T allow inexperienced personnel to work on the generator or electrical equipment.

DON'T remove guards or protective devices.

DON'T wear loose clothing or jewelry in the vicinity of moving parts. These can get in machinery, with disastrous results.

DON'T wear jewelry while working on electrical equipment. If your hair is long, wear a head covering. Hair caught in a drill press, fan belt or other moving part can cause serious injury.

DON'T stand on a wet floor while working on electrical equipment. Use rubber insulated mats placed on dry wood platforms.

DON'T lunge after a dropped tool. To do so may place you in a position of extreme danger.

DON'T commence any operation until you have taken all the necessary steps to ensure that you are in complete safety.

DO

DO perform your tasks carefully, without undue haste.

DO provide fire extinguishers (rated ABC).

DO provide a First Aid Kit (for burns and abrasions). Obtain medical attention, if necessary.

DO use the correct tools for the job you are doing.

DO make sure that all fasteners are secure.

DO use extreme care while making adjustments on the generator set while it is running.

DO keep your hands away from moving parts.

DO remember - Horseplay is for horses! It has no place around machinery.

DO disconnect batteries before starting work on the generator set.

DO use screwdrivers, pliers, diagonal pliers, etc. with insulated handles.

DO remember to keep one hand in your pocket if it is necessary to work on "**live**" circuits. To do so will prevent passage of electricity into one hand and out the other, which passes current across the heart.

DO PRACTICE SAFETY. THE LIFE YOU SAVE MIGHT BE YOUR OWN

SECTION THREE

GENERATOR SET OPERATION

3.1 PRE-START INSPECTION

1. Check fuel level - Use Diesel fuel SAE No. 2-D, No. 1-D in cold weather, or any other equivalent low sulphur content Diesel Fuel as DIN EN 590; BS 2869 Class A-1; JIS No.2; NATO Code F-54 / F-34 / F-44 and XF-63.
2. Check engine oil level – should be at full mark
   Use SAE Multi-grade Oil 10W-40 API rating CC/CD or higher for normal operation and SAE 5W-20 when operating at temperatures below -4ºF (-20ºC).
3. Check coolant level – should be between the two marks on the overflow bottle.
4. Check fan belt for tension and integrity.
5. Make sure that the generator's main Circuit Breaker located in the electrical control box door is in "OFF" position (down).

3.2 STARTING THE UNIT

1. If engine is cold push the "START – PREHEAT" toggle to the left in "PREHEAT" and hold for 5 to 7 seconds. Amp-meter should show DISCHARGE.
2. Push "ON – OFF" switch to "ON" position.
   The green LED "SYSTEM ON" and the red LED "LOW OIL PRESSURE" will come on and the electrical fuel pump will start to operate.
3. Push the "START - PREHEAT" toggle to the right in "START" position in order to crank the engine. Release the switch as soon as the engine has started.
   If engine fails to start after 15 seconds of cranking, reset the system by turning the "ON – OFF" switch to "OFF".
   Repeat steps #2 and 3, and if needed in cold weather also step #1.
   Keep an interval of 15 – 20 seconds between two successive cranking.

NOTE: If for any reason the engine is not started within eight seconds after the "ON – OFF" switch was put in "ON" the timer located in the control box will shut the system down. The green LED "SYSTEM ON" will go off and the red LED "LOW OIL PRESSURE" will stay "ON" until the system is reset.

3.3 AFTER START CHECK-UP

- AC Voltmeter needle should be in the green band indicating ≅ 480 V
- Amp-meter should indicate charging
- Hour-meter indicator should be rotating
- Engine oil pressure gauge should indicate 30 PSI or higher

3.4 ENGINE PPROTECTIONS CONTROLS

There are several safety devices employed to prevent damage to the engine, or the electrical system, should a potentially dangerous situation occur.

The 25 A circuit breaker protects DC components and wiring from a short circuit situation. The breaker will reset periodically until the short circuit is removed.
WHEN A DC CIRCUIT BREAKERS IS REPLACED IT MUST BE INSTALLED PROPERLY WITH THE "BAT" TERMINAL CONNECTED TO THE LINE OR BATTERY SIDE OF THE CIRCUIT AND THE "AUX" TERMINAL CONNECTED TO THE LOAD SIDE OF THE CIRCUIT AS INDICATED ON THE BREAKER

Two safety shutdown devices are used to protect the engine. One is the high temperature switch that actuates at 221°F (105°C). Another is an oil pressure switch that actuates at 14 psi (1kg/cm²).

3.5 TIMER – EMERGENCY STOP UNIT

The TIMER Emergency Stop Unit provides the safety monitoring of the engine.
The TIMER is completely encapsulated into a mounting case and it is able to withstand a wide ambient temperature range from -4°F (-20°C) to +140°F (+60°C) as the shock and weather conditions encountered in transport applications.
The TIMER automatically shuts down the engine in case of High Coolant Temperature and Low Oil Pressure.
The TIMER also shuts down the electrical control system if:

- The engine runs out of fuel or stops for any other reason
- The engine is not started within eight seconds after the "ON–OFF" switch is put in "ON". This prevents battery drain if the "ON-OFF" switch is accidentally pushed in "ON" position.

3.6 LED INDICATORS

The electrical control system is provided with three, high intensity colored (one green and two red) LED located and the upper front side of the control box.

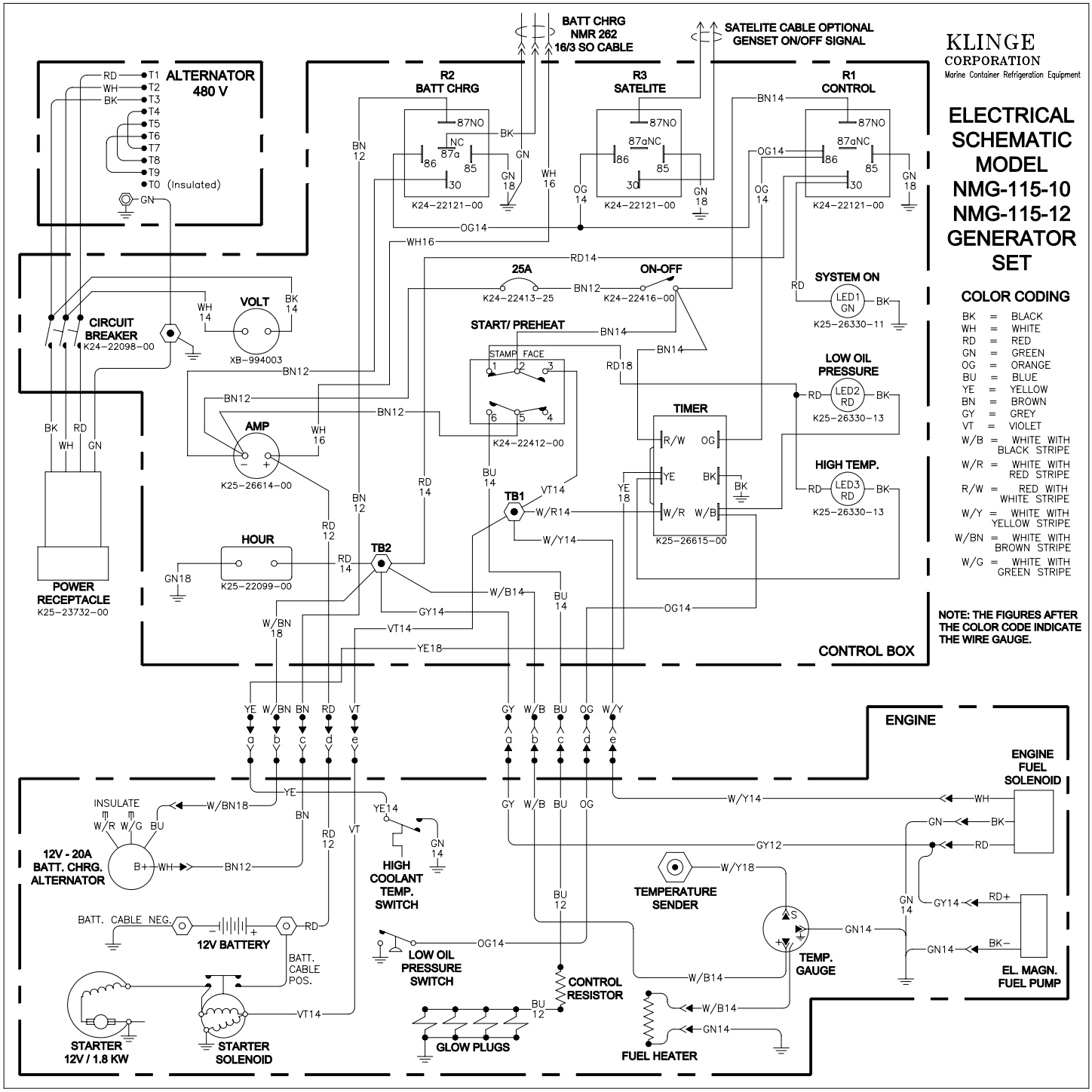
- Green LED : "SYSTEM ON"
- Red LED: "LOW OIL PRESSURE"
- Red LED: "HIGH COOLANT TEMPERATURE"

Red LED -LOW OIL PRESSURE- "ON" indicates that the unit is shut down either for low oil pressure, or engine has run out of fuel, or that the ON-OFF switch was accidentally turned ON.
Both red LED – LOW OIL PRESSURE and HIGH COOLANT TEMPERATURE- "ON" indicate that the unit is shut down for high coolant temperature.

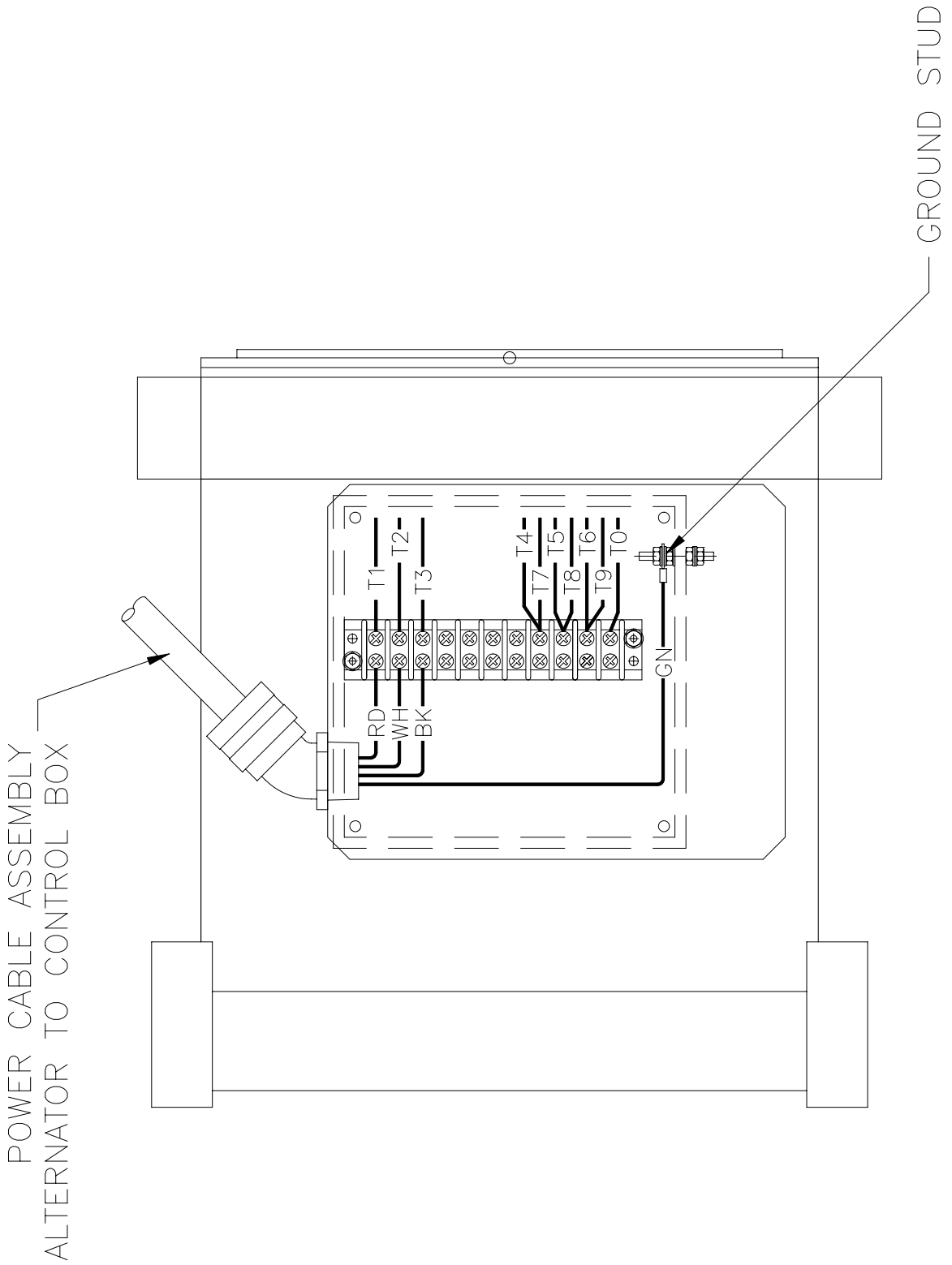
3.7 ENGINE SPEED (RPM) AND FREQUENCY

The engine must be set to run at 1800 to 1850 rpm corresponding to a frequency of 60 to 62 Hz at FULL LOAD.
Full load is considered to be when the reefer unit runs in an ambient of + 90 to 100°F (+ 32 to 38° C) and the box temperature is + 32°F (0°C) or above.

NOTES:
1/ AVOID OVERE SPEEDING SINCE ALTERNATOR VOLTAGE CAN RISE UP TO 525 – 550 VOLT AND SEVERE DAMAGES CAN OCCUR.
2/ UNDER NO CONDITIOND SHOULD THE RPM BE BELOW 1800 RPM (60 Hz).



ELECTRICAL SCHEMATIC



TOP VIEW
ALTERNATOR WIRING
INSIDE JUNCTION BOX

SECTION FOUR
MAINTENANCE AND COMPONENTS INFORMATION

4.1 FUEL SYSTEM

The fuel injection pumps and fuel injection nozzles are precisely manufactured and therefore using fuel which contains water or dust particle will result in equipment seizure, costly damages and decreased engine output.

Replace fuel filter element after every 500 hrs of operation.

Use KLINGE XB-998162-2 filter element.

Before starting the unit check for leaks and for water in the filter bowl. Drain if necessary.

Use SAE No.2-D Diesel fuel, 1-D in cold weather.

Following standards are also approved: DIN EN 590; BS 2869 Class A-1; JIS No.2; NATO Code F-54 / F-34 / F-44 and XF-63.

If not available select a Diesel fuel with low sulphur and high cetane value.

DO NOT USE:

- Diesel fuel that has been contaminated with engine oil, they can cause engine damage and can also affect emission control.
- Fuel additives, except "Biocide" ones, if required.

4.2 COMBUSTION AIR INTAKE SYSTEM

Engine performance and life depends on the intake air condition.

Replace air filter cartridge after every 500 Hrs. of operation.

Use KLINGE K26 25091 08 filter cartridges.

After 250 hours of operation, or more often if the generator set is operated in a dusty environment, remove the filter cartridge and blow, only from the inside, air at a pressure of 45 –7o PSI (3 – 5 kg/cm^2) to remove the dust.

Take care to not damage the filter element during the cleaning and to not cause air leakage (sucking) when the air cleaner is reassembled.

4.3 LUBRICATION

A correct oil and filter service will ensure good performances and a long engine life.

Change oil and filter after initial 50 hours of operation. Afterwards change the oil every 250 hrs and filter every 500 hrs of operation or at least once in a year.

Use SAE Multigrade Oil SAE 10W-40 API rating CC / CD or higher and SAE 5W-20 when operating at temperatures below -4°F (-20°C).

Use KLINGE XB-998209 filter element.

Check the oil level before every start, add oil if required up to the FULL mark.

CAUTION: Never mix up different brand or different type of oils.

4.4 COOLING SYSTEM

Use 50/50 Ethylene Glycol / Water solution. Never exceed 60 / 40 antifreeze water mix.

NOTE: Concentrations over 65% Ethylene Glycol adversely affects freeze protection, heat transfer rates and silicate stability that may cause water pump leakage

Replace coolant every two years.

Check the hoses and pump for leaks and the coolant level. With a cool engine the liquid level should be between the two marks on the expansion tank.

4.5 FAN BELT

Check the fan belt for tension and integrity before every starting.
Replace if necessary using KLINGE K26 25145 112 belt.

4.6 VALVE CLEARANCE ADJUSTMENT

It is re commended to adjust the valve clearance every 1000 operating hours, or whenever the valve rocker is abnormally noisy or in an engine malfunction though the fuel system is properly working.
With a cold engine the valve clearance, both intake and exhaust, is 0.0157 inches (0.40) mm.
CAUTION: The rocker arms are made of die-cast aluminum. Therefore be careful not to tighten the adjusting screw to excess.

4.7 INJECTION TIMING ADJUSTMENT

The injection timing needs not to be readjusted.
When an injection pump is removed for any reason, at reassembling take care to not forget to insert the shim on the mounting surface.

4.8 CYLINDER COMPRESSION MEASUREMENT

The cylinder compression pressure measurement must be done whenever the engine output is reduced.

Compression pressure:	441 PSI (3.04 MPa)
Test condition:	Cranking speed 250 RPM.
	Coolant temperature 167°F (75°C.

NOTE: Repair the engine and / or replace some parts if compression pressure is lower than 370 PSI (2.55 MPa)

4.9 FUEL INJECTIONS NOZZLES

An injection nozzle test is required any time when the engine output is reduced and blackish exhaust smoke is present.
Testing should be performed in a specialized shop where the necessary equipment is available.
Tests should be performed to check the static injection starting pressure and the fuel spray conditions. The injection nozzle opening pressure should be 2560 PSA (17.7 MPa).

4.10 BATTERY

Keep the battery fully charged all the time, it is important especially in cold season.
Keep the battery posts clean and the battery cables tighten securely.
Always disconnect the battery negative cable when work on the unit is performed.
If distillated water is needed to be added, do it before the unit will be operated, otherwise the water will not mix with the acid and can freeze in cold weather.

4.11 ARTER AND BATTERY CHARGING ALTERNATOR

The starter and the battery charging alternator servicing consists of:

- Check the carbon brushes and the brush contact
- Clean the alternator slip ring.

Avoid to spray water or steam on the alternator and on the starter, it may cause damages.

SECTION FIVE

5.1 TROUBLE SHOOTING

The following trouble shooting chart is by no means complete, but covers the more general type problems, which would most likely occur if a breakdown are experienced.

POSSIBLE CAUSE	CORRECTIVE ACTION SUGGESTED
Problem: Engine starter will not energize	
Loose or corroded Battery Terminals	Clean terminals and tighten
Battery Voltage too low	Recharge or replace battery
Faulty START / PREHEAT Switch	Replace
Faulty ON / OFF Switch	Replace
Faulty Starter Solenoid	Replace
Faulty Starter Motor	Replace
Circuit Breaker Open	Replace if it does not reset
Problem: Starter turns but engine does not ignite	
Faulty control Relay R1	Replace
Faulty emergency stop Timer	Replace
Faulty Engine Fuel Solenoid	Replace
Control rack is stuck in stop position	Remedy
Engine too hot and protection system will not allow to operate	Allow engine to cool will not allow starter
Faulty coolant Temperature Switch	Replace switch
Faulty electrical Fuel Pump	Replace
No Fuel	Add fuel to tank
Clogged fuel filter element	Replace

POSSIBLE CAUSE	CORRECTIVE ACTION SUGGESTED
Problem: Engine starts but stalls immediately	
Air in the fuel system	Remedy and bleed the system
Defective oil pressure Switch Low oil pressure LED stays ON	Replace switch
Oil level to low	Add oil
Problem: Engine stops with high engine temperature indication	
Coolant temperature too high	Check cooler for air flow restriction and clean or remove restriction
Coolant level too low	Add coolant
Defective high temperature switch	Replace switch
Thermostat malfunction	Replace
Fan belt slippage or broken	Remedy or replace
Problem: Black exhaust	
Clogged air filter	Clean the filter cartridge or replace
Improper fuel – low cetane grade	Replace fuel
Nozzle damage	Repair or replace nozzle
Problem: White smoke	
Water mixed in fuel	Replace fuel and clean fuel filter
Low compression pressure	Check compression
Low coolant temperature	Check thermostat and replace if needed
Problem: Unstable engine running (Hunting)	
Defective governor spring	Replace
Incorrect valve adjustment	Adjust valve clearance

POSSIBLE CAUSE	CORRECTIVE ACTION SUGGESTED
Problem: No voltage at power receptacle but AC voltmeter needle is in the green band	
Main Circuit Breaker is on OFF position	Turn main circuit breaker ON
Defective main Circuit Breaker	Replace
Problem: No AC voltage	
No residual magnetism in the alternator exciter field	Restore magnetism by flashing field See 5.2 "Restoring residual magnetism
Open in main stator windings	Check for continuity in windings See 5.3 Checking main stator windings
* Open or short in rotating diodes	Check rotating diodes and replace if needed
* Open in alternator field	Check for continuity. If field coils are open, replace the rotor or repair it.
* Shorted exciter armature	Check for short and replace if faulty. Use a Kelvin type bridge to measure this resistance
* Shorted leads between exciter armature and generator field	Test and repair
Problem: Low voltage	
Low speed	Check engine speed or system for overload.
Excess load	Reduce load. The load on each leg should be as evenly balanced as possible and should not exceed the rated current on any leg.
High resistance connections – Connections will be warm or hot	Make better connections, electrically and mechanically.
Shorted field	Test field coils for possible short. Use an Ohmmeter or resistance bridge. Repair or replace rotor if alternator field coils are shorted.

NOTE: * Designated rotating parts. The rear alternator cover (bearing carrier) must be removed in order to perform the test.
For instructions how to perform the tests see "ALTERNATOR MANUAL" at the end of this Manual.

POSSIBLE CAUSE	CORRECTIVE ACTION SUGGESTED
Problem: Fluctuating voltage	
Irregular engine speed	Check engine for malfunction.
Loose terminal or load connections	Make better connections.
Defective bearing causing uneven gap	Replace alternator bearing.
Problem: Overheating	
Generator overloaded	Reduce load. Check with Amp-meter and Compare with alternator nameplate rating.
Unbalanced load	The load on each leg should be as evenly balanced as possible and should not exceed the rated current on each leg.
Dry bearing	Replace bearing
Clogged vent ducts	Clean air passages

SECTION 6
SERVICE PARTS

DIESEL GENERATOR SET
MODEL NMG-115-10 & NMG-115-12

NMG-115-10 / BRG-540 / COG-340

GENERAL

The engine models used on the this generator sets are **ISUZU 4LEIPV** (indirect injected) or **4LE2PV** (direct injected) pending on the specific application of the unit.
Since the manufacturer can change parts numbers any time without prior notice, in order to be sure to receive the correct part, when ordering please indicate:

- Model and serial number of the engine
- Figure number from the attached "Illustration Index" where the part is located, a description of the part and the number attached to it.

NOTE: the **Engine ID No.** can also be used for identifying the correct needed part
The engine ID can be found on the bottom of the emission label located underneath the injector #3.

The power alternator is a **Marathon Electric LIMA MAC Reefer** model **260MSL1361.**
Due to the same reason as shown above for the engine when asking for spare parts please indicate the serial number of the alternator.

LIST OF FREQUENTLY USED SERVICE AND MAINTENANCE PARTS

Description	Part No.
ENGINE	
- Oil filter	XB-998209
- Primary fuel filter element	K26 25180 02
- Bowl with heater, primary fuel filter	K26 25180 03
- Bowl O-ring & seal service kit, primary fuel filter	K26 25180 04
- Fuel pump electrical	K26 25179 00
- V-belt (fan & alternator) 836 mm long 4LE1PV engine	XB-998202
- V-belt (fan & alternator) 855 mm long 4LE1PV & 4LE2PV engines	XB-998202-855
- Air filter cartridge	K26 25091 08
- Hose radiator inlet (top tank)	XB-340024
- Hose radiator outlet (bottom tank)	XB-340025-01
- Temperature gauge	K26 25177 00
- Temperature sender	K26 25178 00
- High temperature switch	XB-998207
- Oil pressure gauge	XB-994130
- Hose oil pressure gauge	XB-216562-10
- Stop solenoid	XB-998206
- Starter motor	XB-998203
- Alternator battery charging 20A (permanent magnet)	XB-998204-20
- Alternator battery charging 35A	XB-998204-35
- Glow plug 4LE1PV engine	XB-998213
- Glow plug 4LE2PV engine	XB-243213-02
- Control resistor, glow plugs 4LE1PV and 4LE2PV engines	XB-998214
- Gasket Exhaust flange	XB-998217
POWER ALTERNATOR	
- Rectifier assembly	XB-997880
- Bearing	XB-997881

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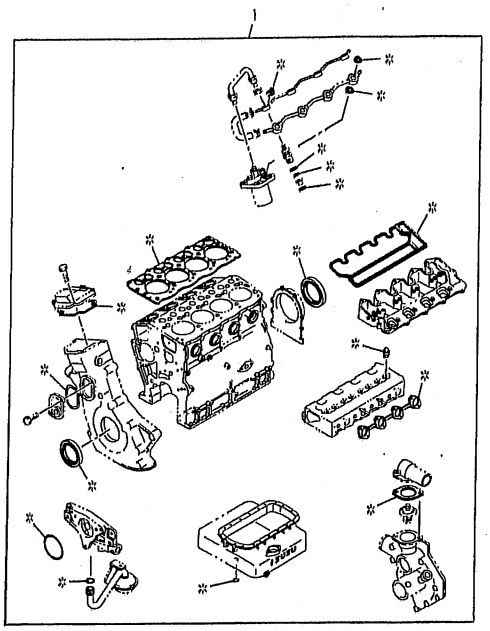
0-05	ENGINE GASKET KIT
FIG-NO.	



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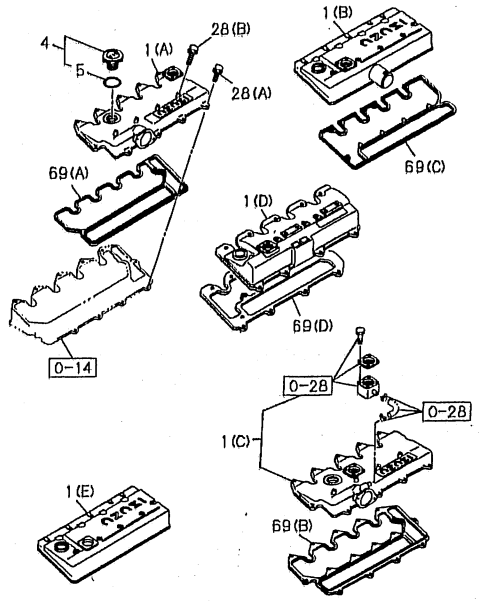
0-10	CYLINDER HEAD COVER
FIG-NO.	



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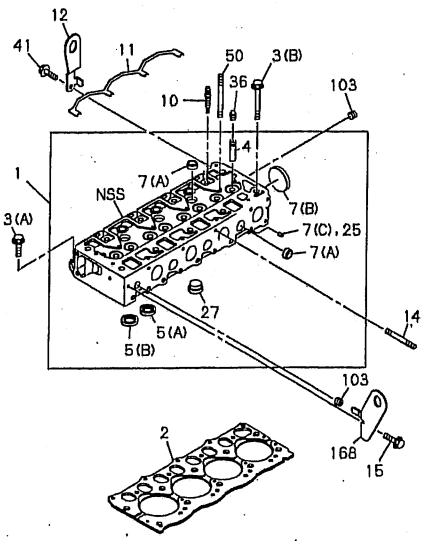
0-11	CYLINDER HEAD
FIG-NO.	



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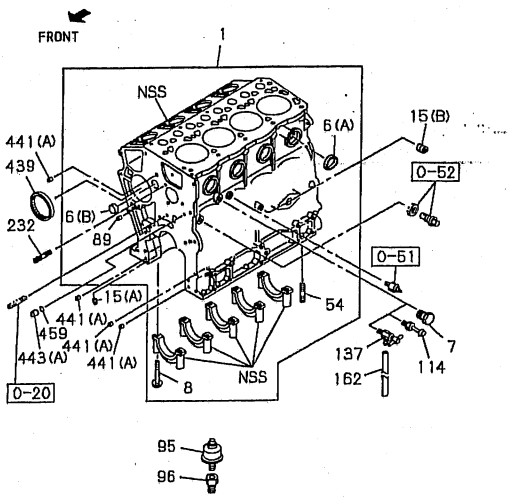
0-12	CYLINDER BLOCK
FIG-NO.	(NO.1)



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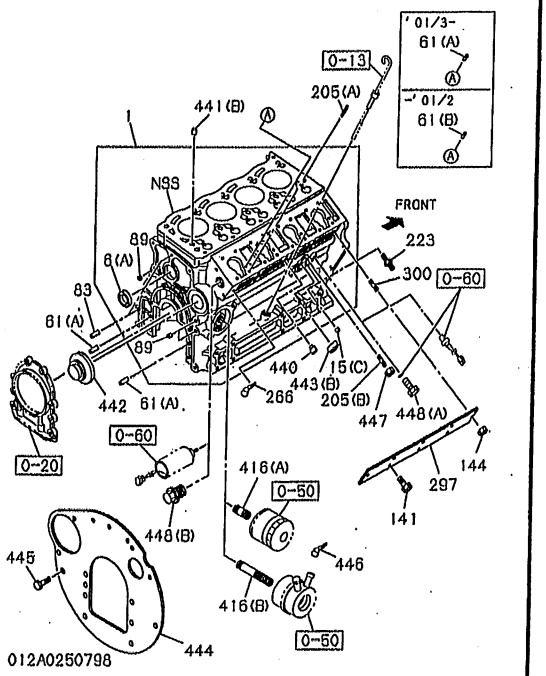
0-12	CYLINDER BLOCK
FIG-NO.	(NO.2)



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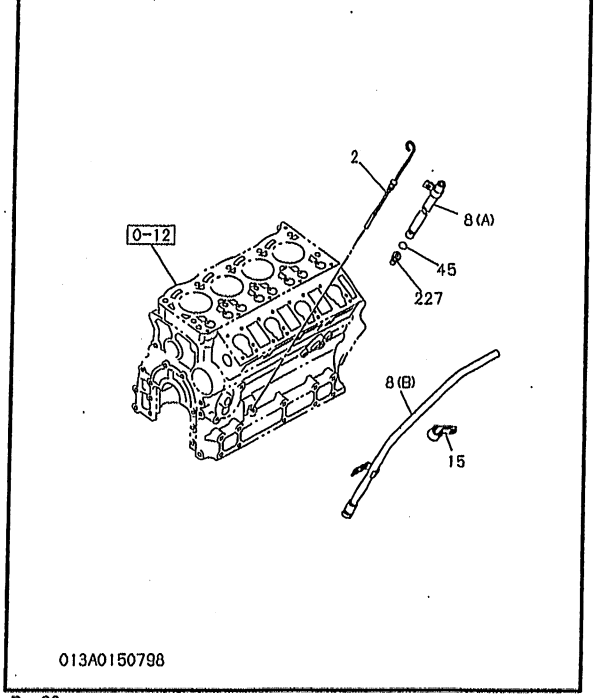
0-13	OIL PAN AND LEVEL GAUGE
FIG-NO.	(NO.1)



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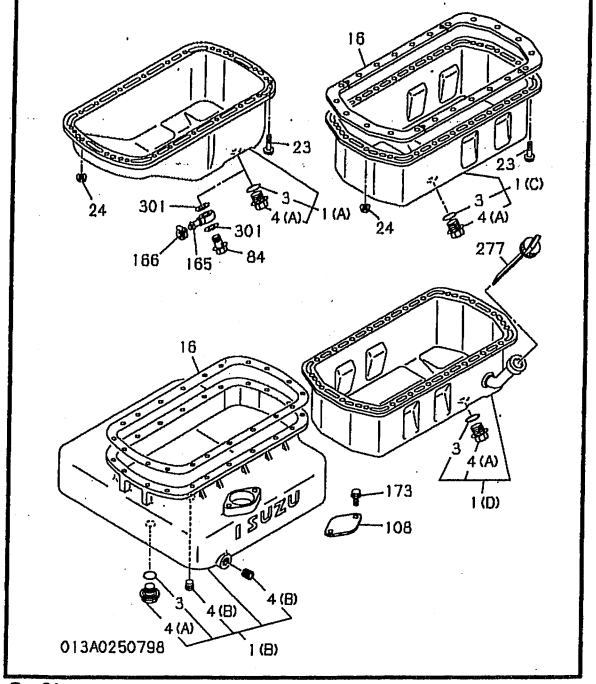
0-13	OIL PAN AND LEVEL GAUGE
FIG-NO.	(NO.2)



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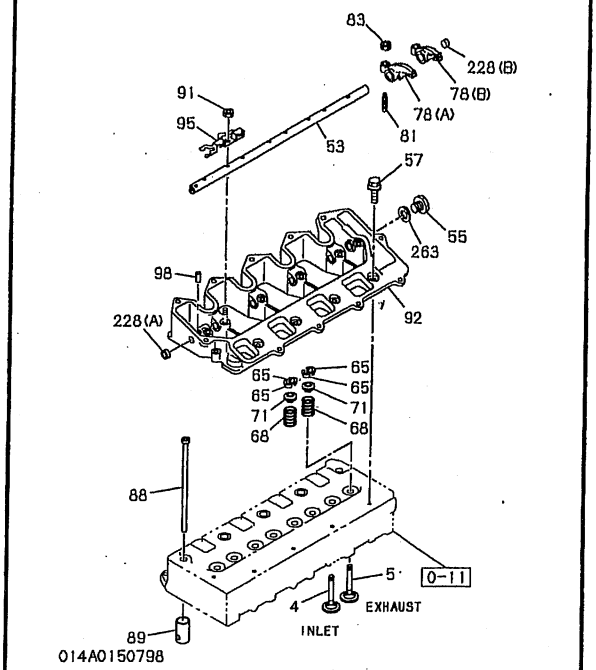
0-14	CAMSHAFT AND VALVE
FIG-NO.	(NO.1)



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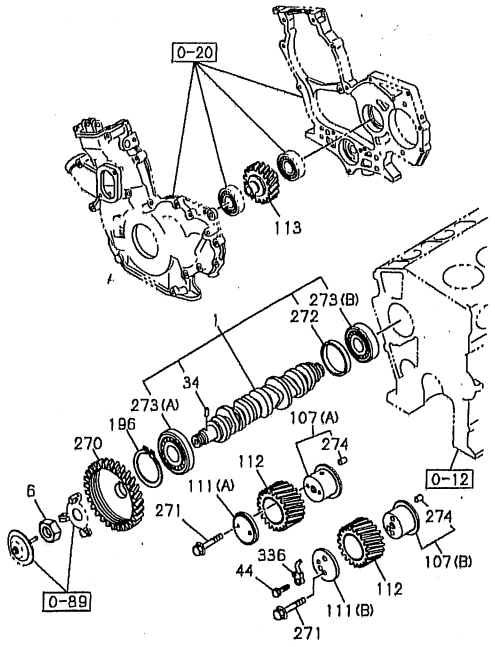
0-14	CAMSHAFT AND VALVE
FIG-NO.	(NO. 2)



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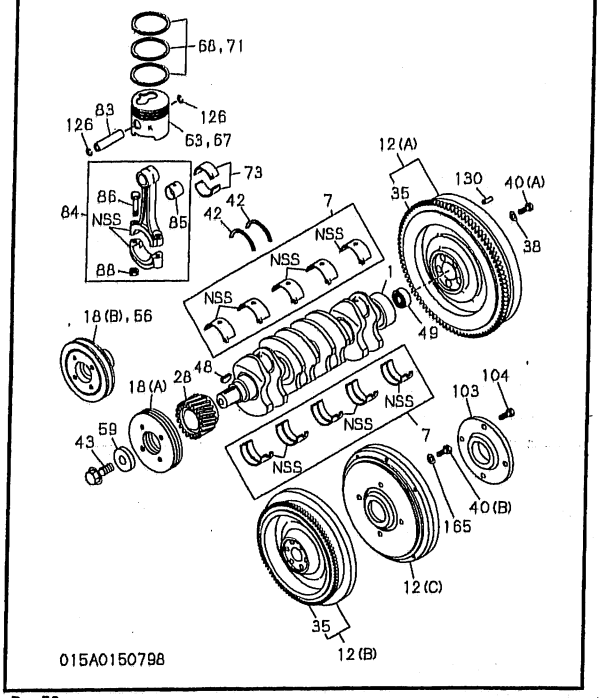
0-15	CRANKSHAFT, PISTON AND FLYWHEEL
FIG-NO.	



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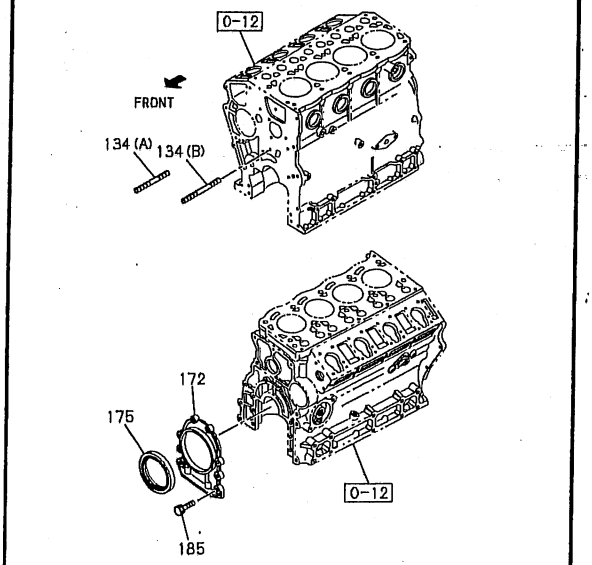
0-20	TIMING GEAR CASE AND FLYWHEEL HOUSING
FIG-NO.	(NO. 1)



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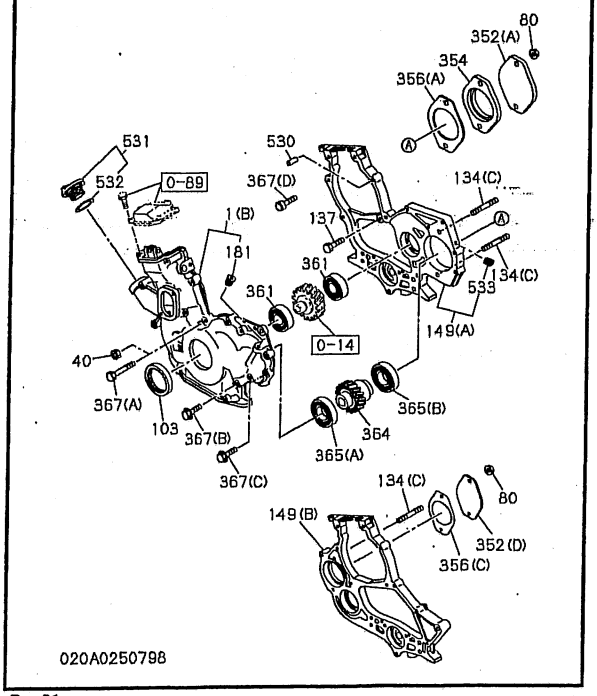
0-20	TIMING GEAR CASE AND FLYWHEEL HOUSING
FIG-NO.	(NO. 2)



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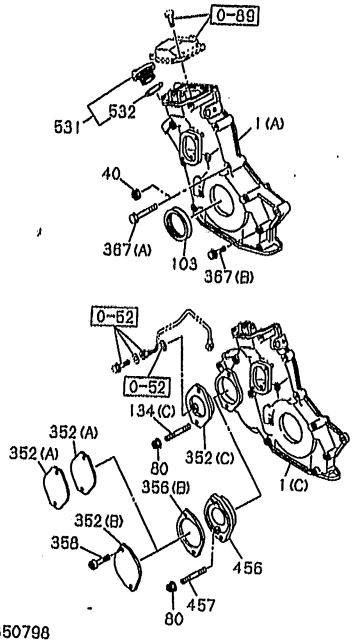
0-20	TIMING GEAR CASE AND FLYWHEEL HOUSING
FIG-NO.	(NO.3)



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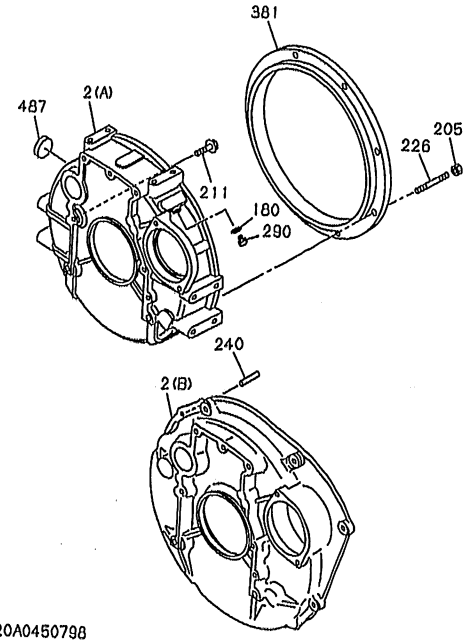
0-20	TIMING GEAR CASE AND FLYWHEEL HOUSING
FIG-NO.	(NO.4)



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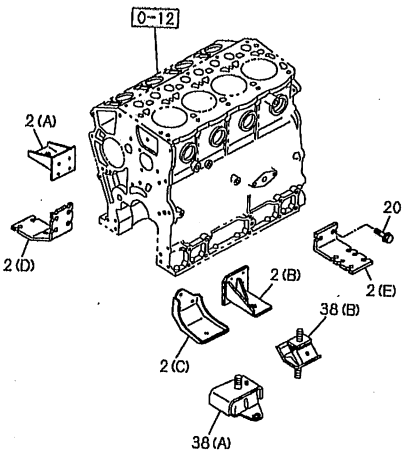
0-22	ENGINE MOUNTING
FIG-NO.	



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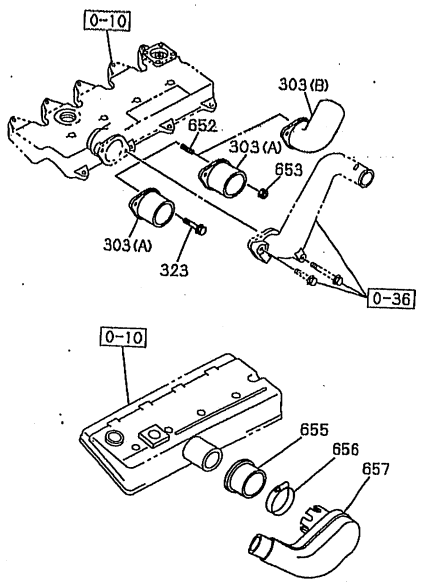
0-25	INLET MANIFOLD
FIG-NO.	



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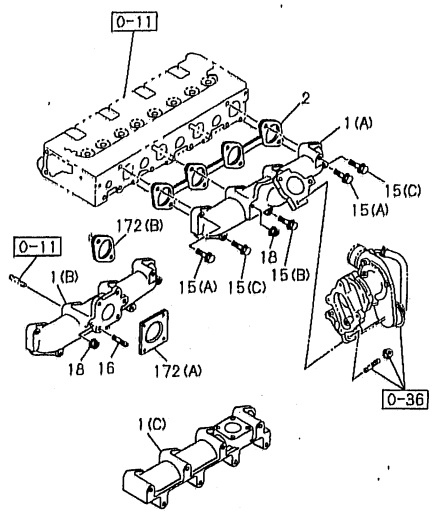
0-27	EXHAUST MANIFOLD
FIG-NO.	



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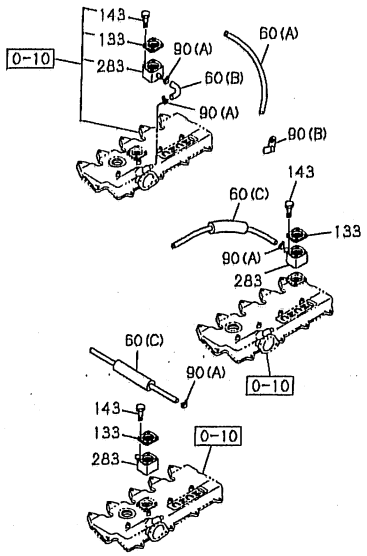
0-28	VENTILATION SYSTEM
FIG-NO.	



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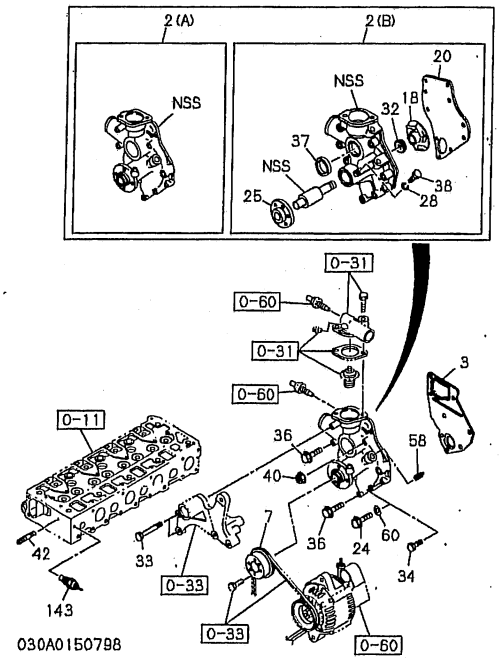
0-30	WATER PUMP AND CORROSION RESISTOR
FIG-NO.	



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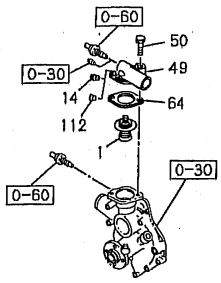
0-31	THERMOSTAT AND HOUSING
FIG-NO.	



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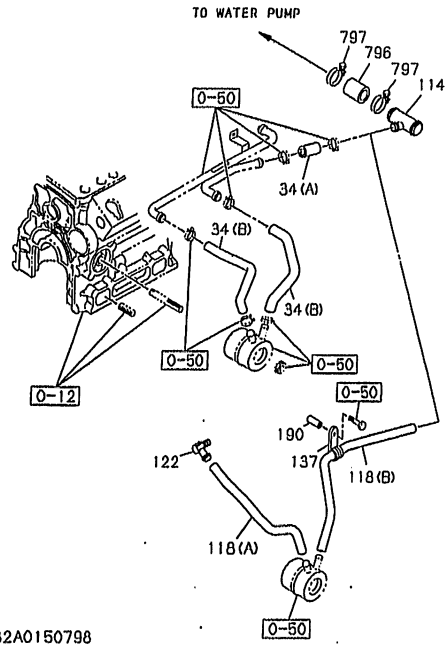
0-32	WATER PIPING; ENGINE
FIG-NO.	



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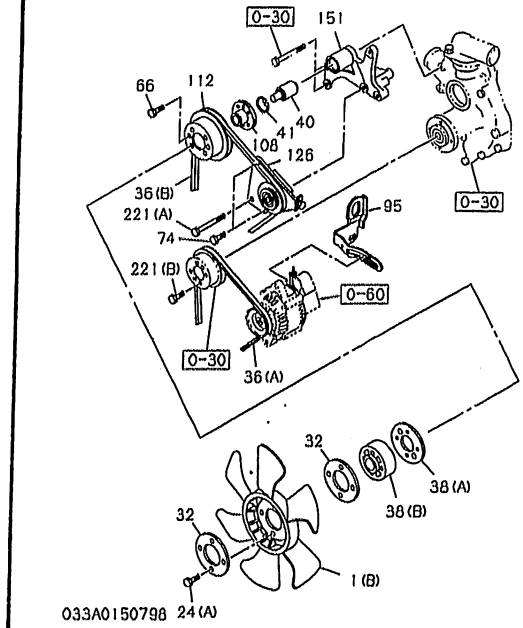
0-33	FAN AND FAN BELT
FIG-NO.	(NO. 1)



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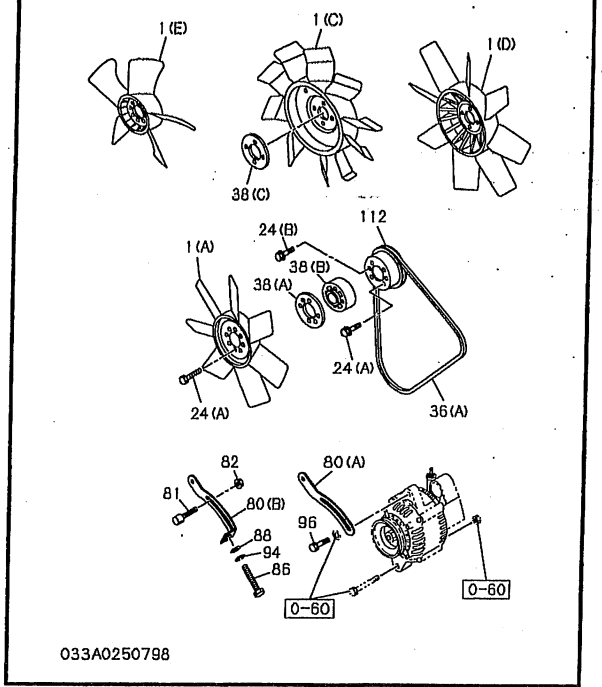
0-33	FAN AND FAN BELT
FIG-NO.	(NO. 2)



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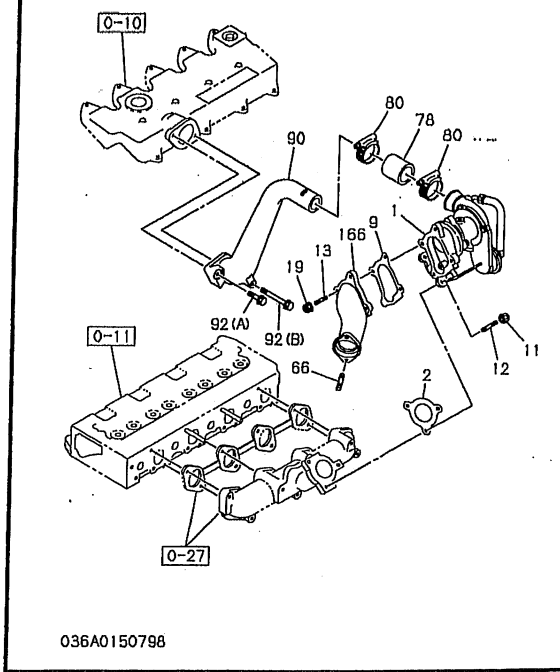
0-36	TURBOCHARGER SYSTEM
FIG-NO.	



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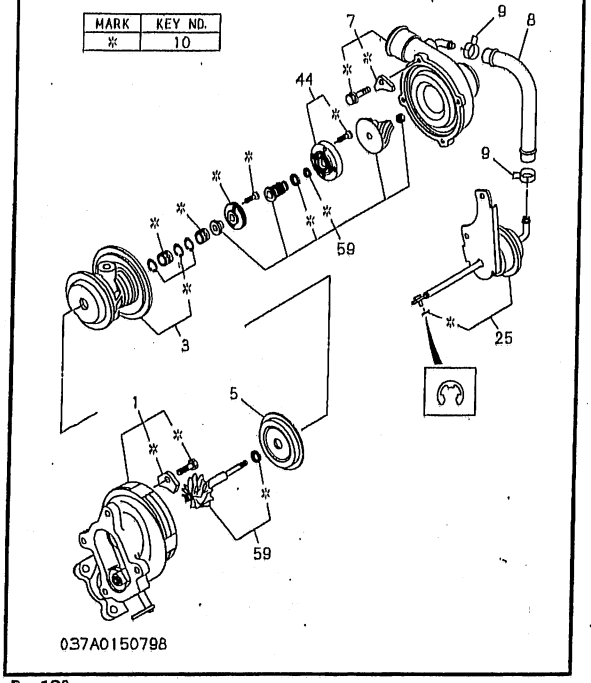
0-37	TURBOCHARGER
FIG-NO.	



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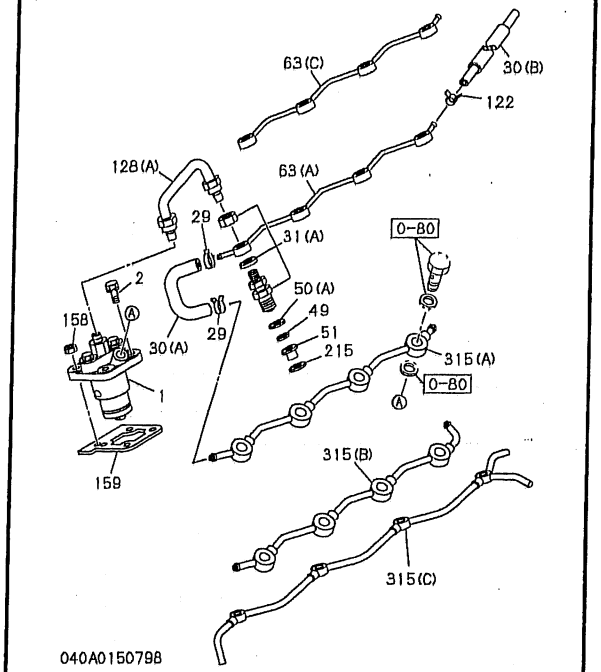
0-40	FUEL INJECTION SYSTEM
FIG-NO.	(NO.1)



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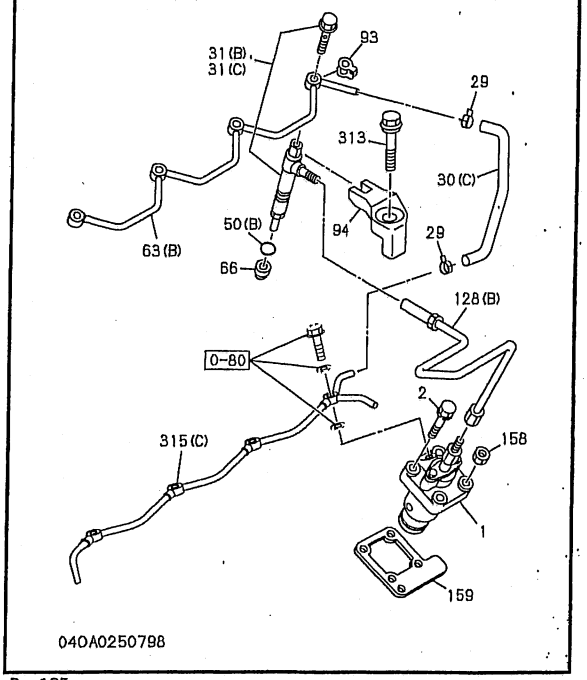
0-40	FUEL INJECTION SYSTEM
FIG-NO.	(NO.2)



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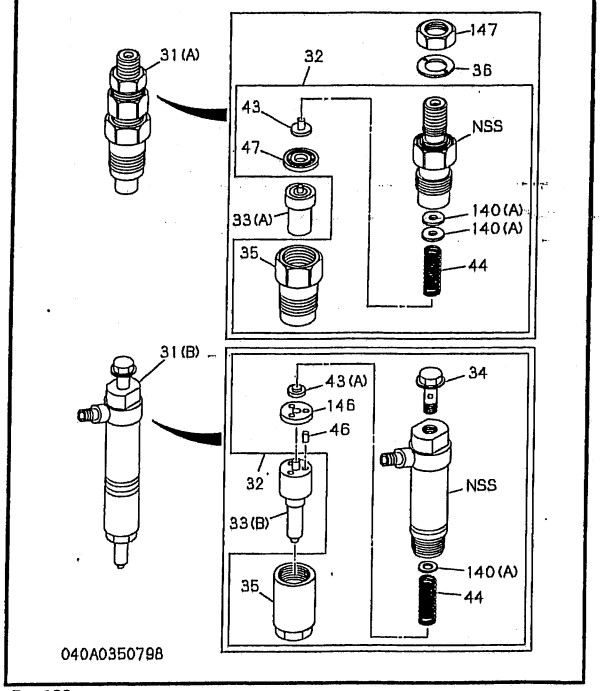
0-40	FUEL INJECTION SYSTEM
FIG-NO.	(NO.3)



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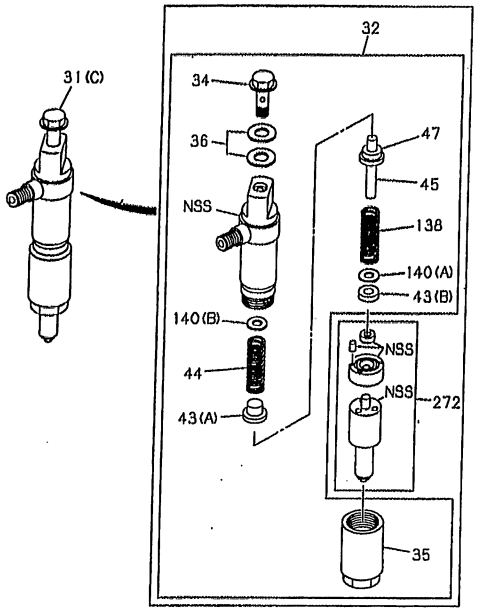
0-40	FUEL INJECTION SYSTEM
FIG-NO.	(NO.4)



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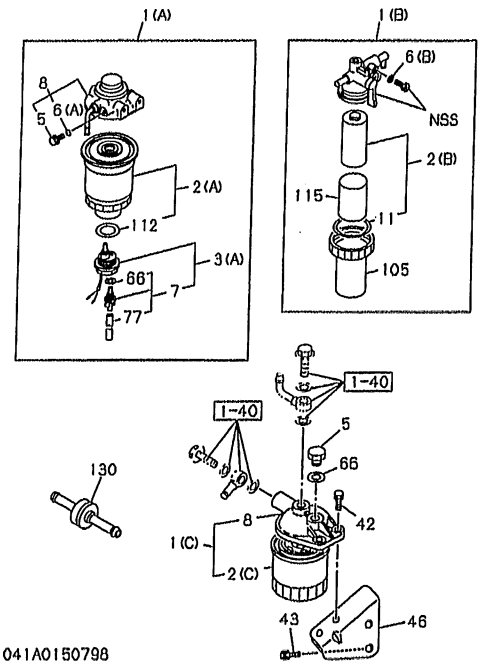
0-41	FUEL FILTER AND BRACKET
FIG-NO.	(NO.1)



041A0150798

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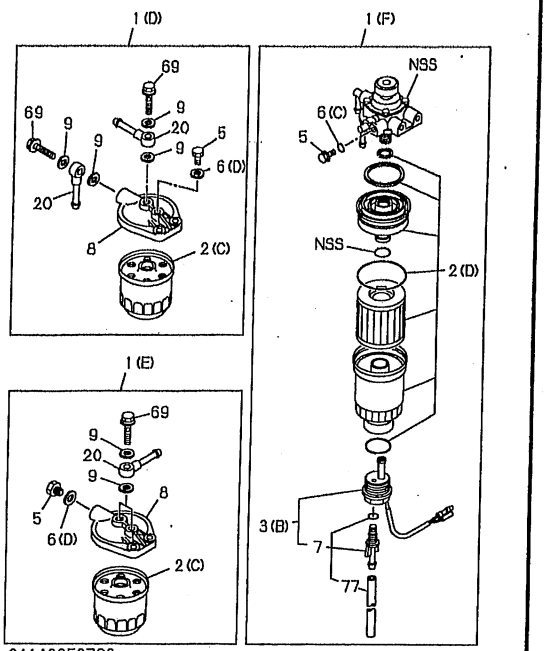
0-41	FUEL FILTER AND BRACKET
FIG-NO.	(NO.2)



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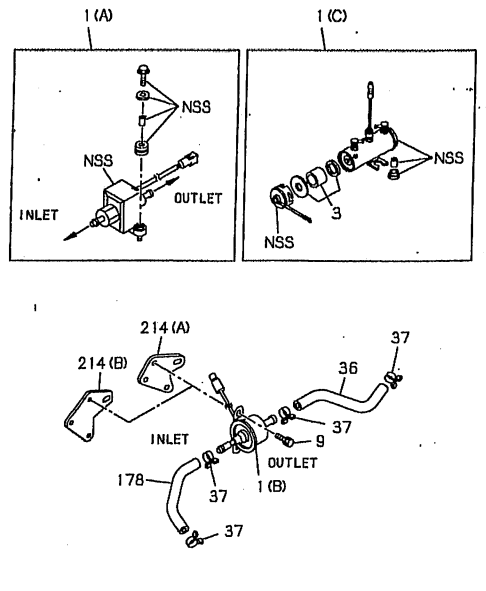
0-42	FUEL PUMP AND PIPE
FIG-NO.	



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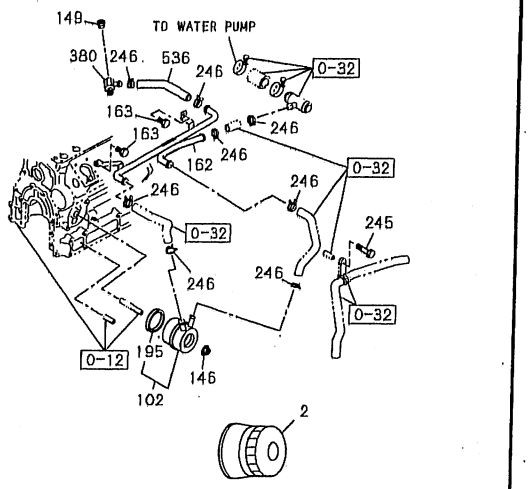
0-50	OIL COOLER AND OIL FILTER
FIG-NO.	



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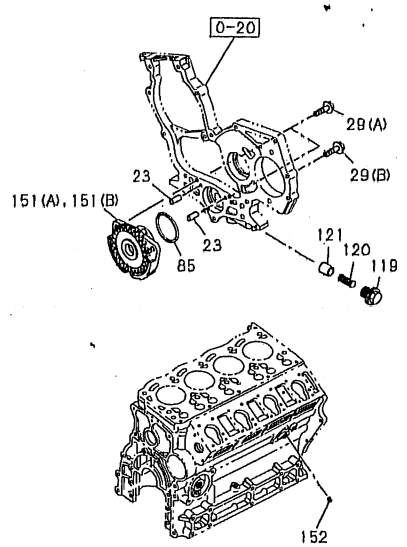
0-51	OIL PUMP AND OIL STRAINER
FIG-NO.	(NO.1)



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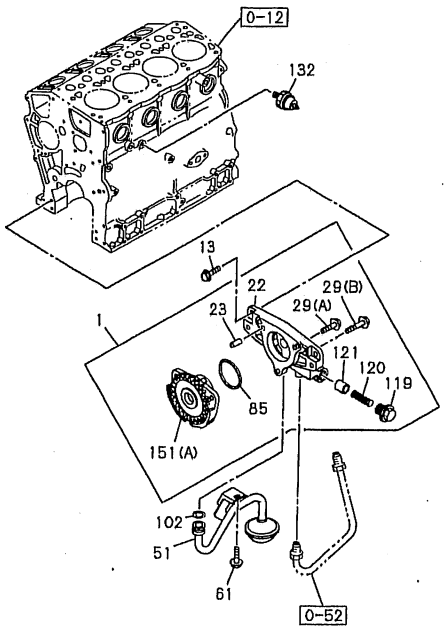
0-51	OIL PUMP AND OIL STRAINER
FIG-NO.	(NO.2)



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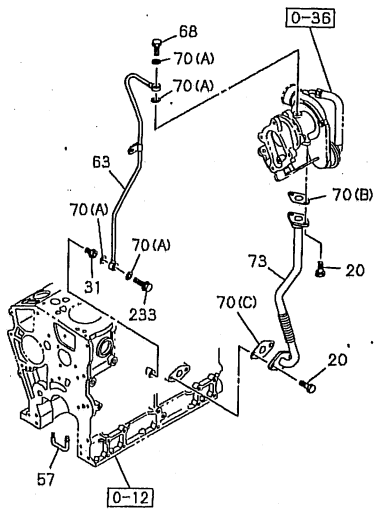
0-52	OIL AND VACUUM PIPING; ENGINE
FIG-NO.	(NO.1)



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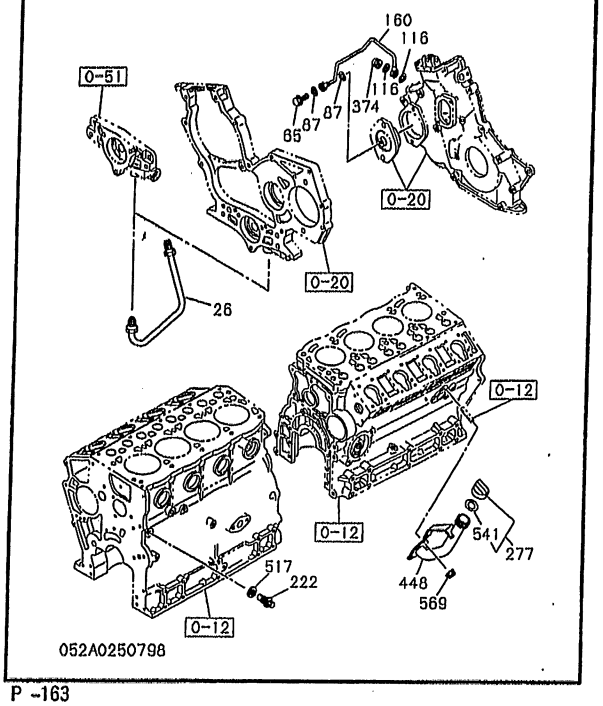
0-52	OIL AND VACUUM PIPING; ENGINE
FIG-NO.	(NO. 2)



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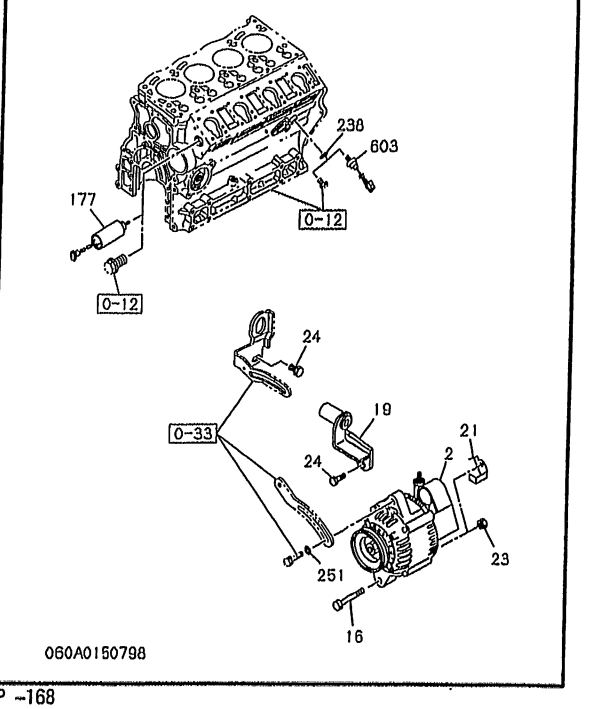
0-60	ENGINE ELECTRICAL CONTROL PARTS
FIG-NO.	(NO. 1)



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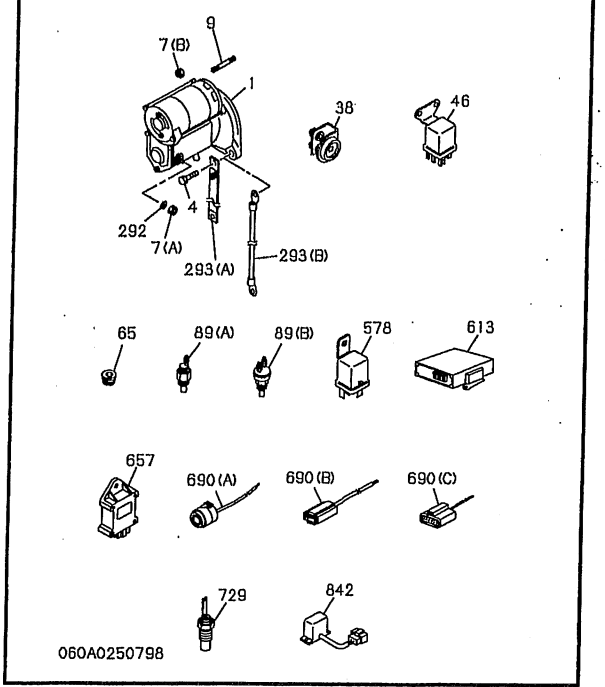
0-60	ENGINE ELECTRICAL CONTROL PARTS
FIG-NO.	(NO. 2)



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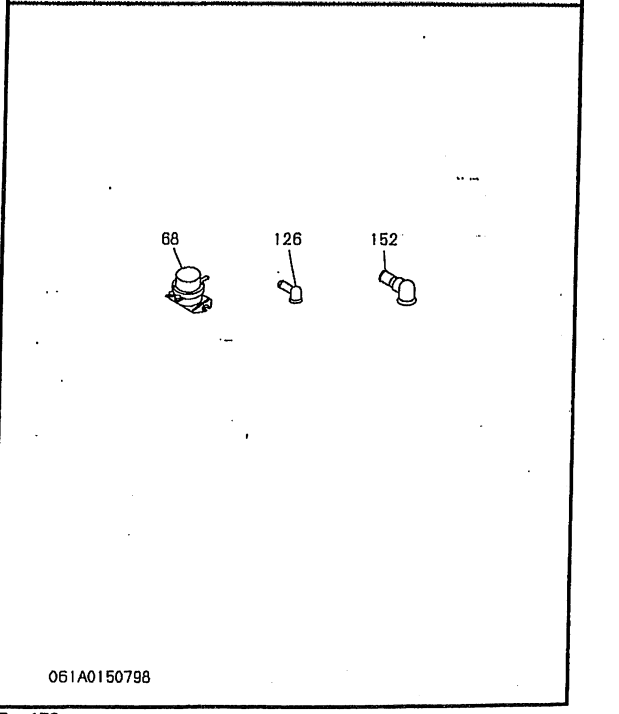
0-61	BATTERY AND BATTERY CABLE
FIG-NO.	



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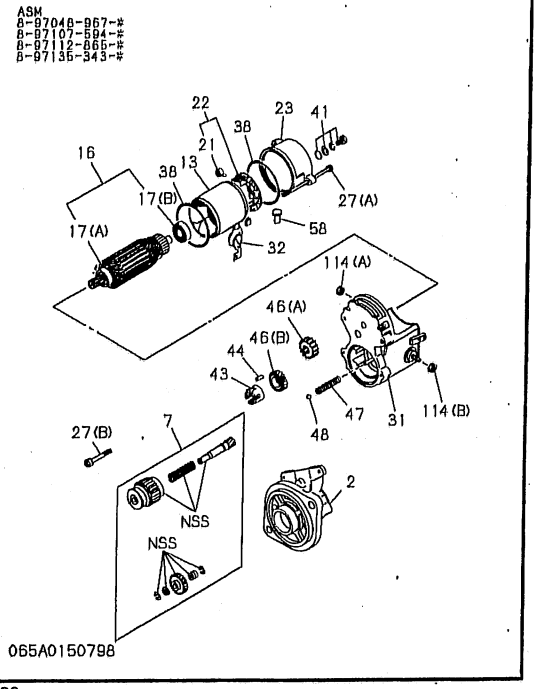
0-65	STARTER
FIG-NO.	(NO. 1)



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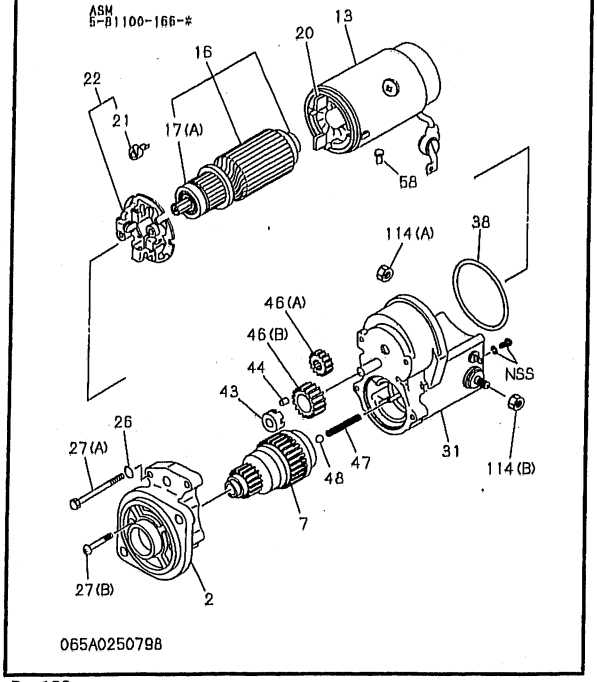
0-65	STARTER
FIG-NO.	(NO. 2)



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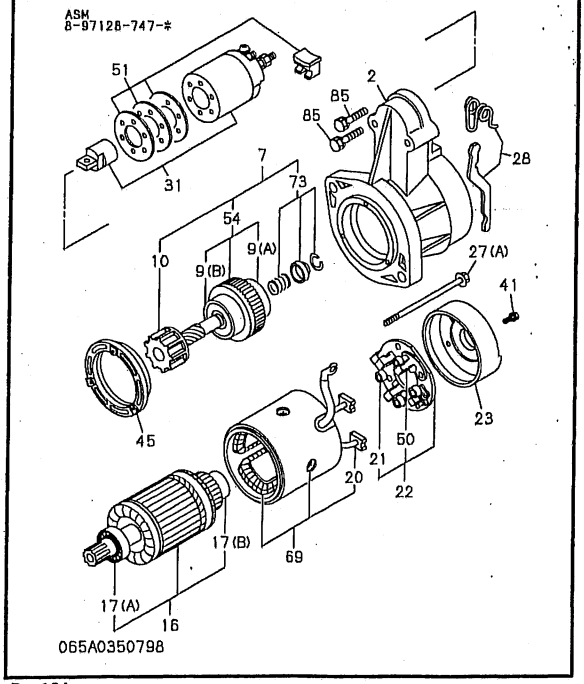
0-65	STARTER
FIG-NO.	(NO. 3)



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0-65	STARTER
FIG-NO.	(NO. 4)

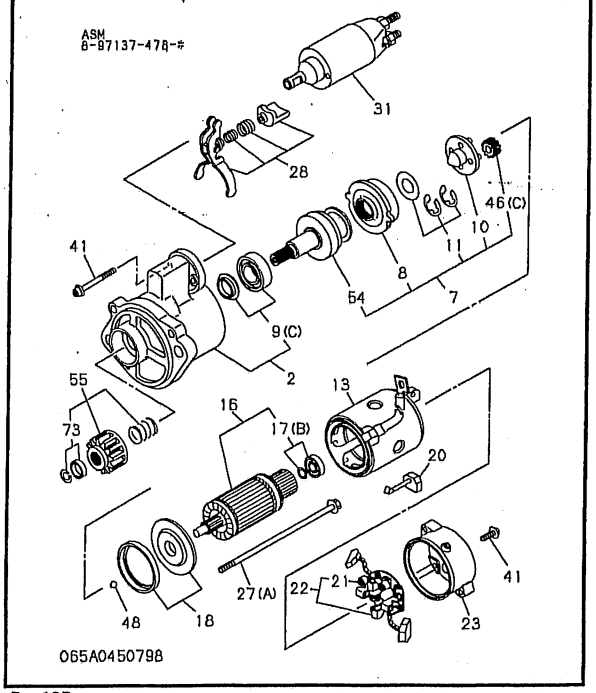

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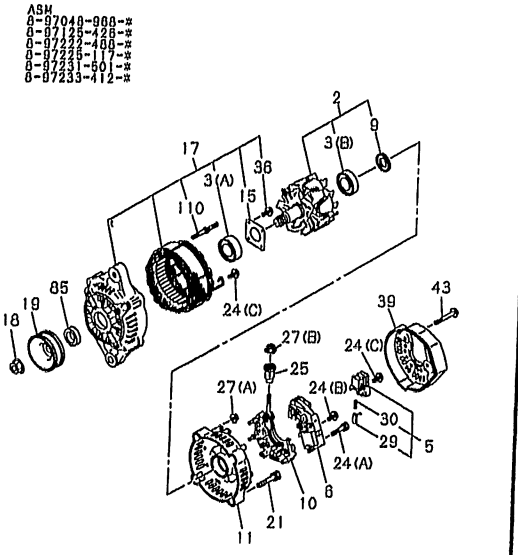
ILLUSTRATION INDEX

0-66	GENERATOR
FIG-NO.	(NO. 1)



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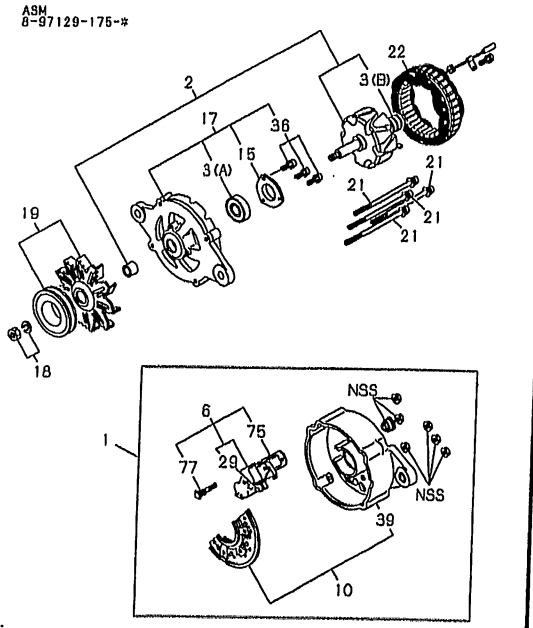
0-66	GENERATOR
FIG-NO.	(NO. 2)



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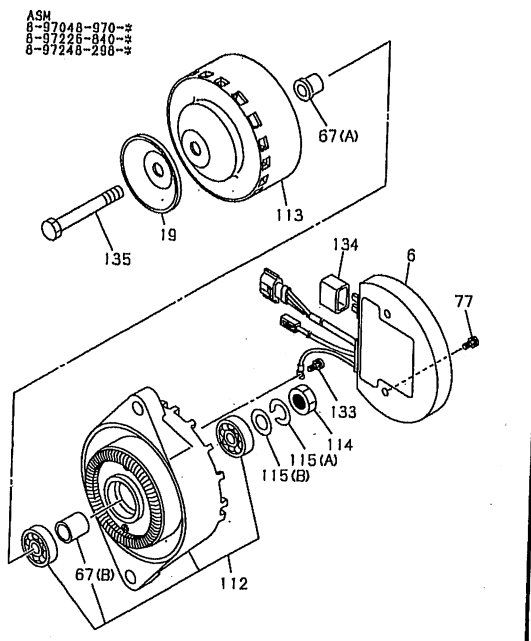
0-66	GENERATOR
FIG-NO.	(NO. 3)



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0-66	GENERATOR
FIG-NO.	(NO. 4)

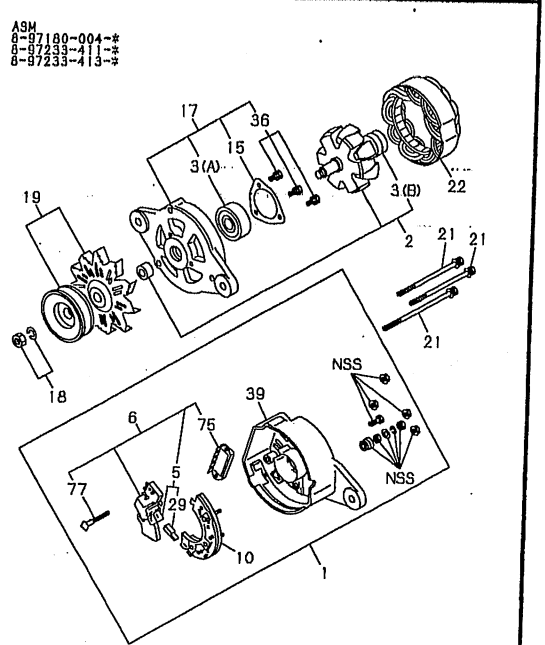

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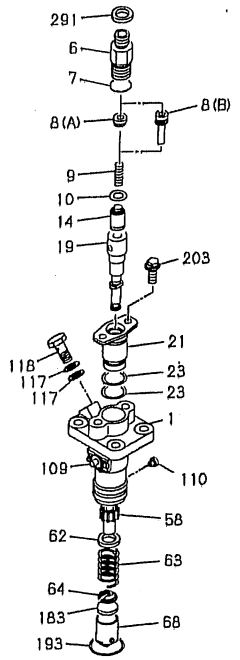
ILLUSTRATION INDEX

0-80	INJECTION PUMP
FIG-NO.	



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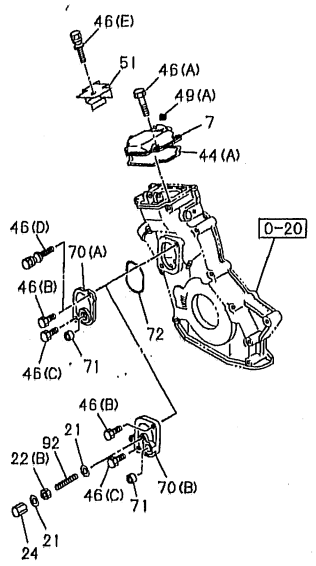
0-89	TIMING CHAIN CASE
FIG-NO.	(NO.1)



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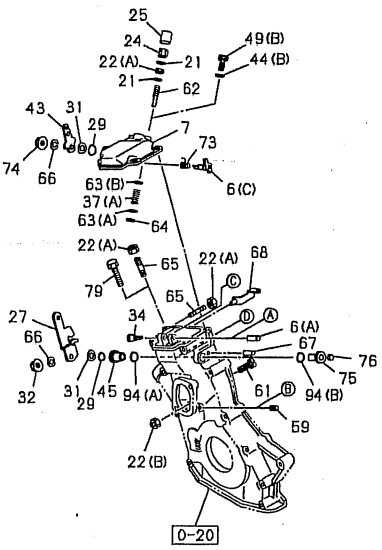
0-89	TIMING CHAIN CASE
FIG-NO.	(NO.2)



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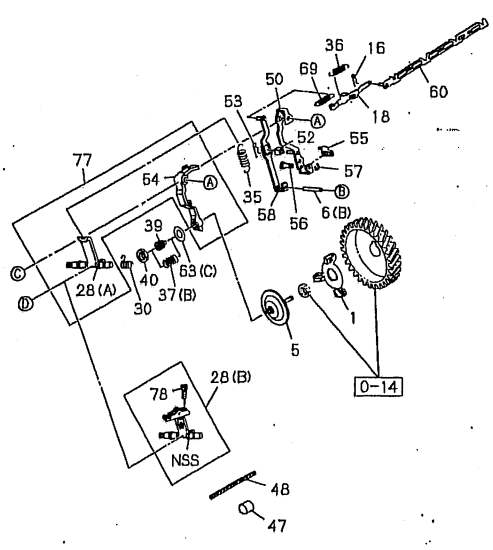
0-89	TIMING CHAIN CASE
FIG-NO.	(NO.3)



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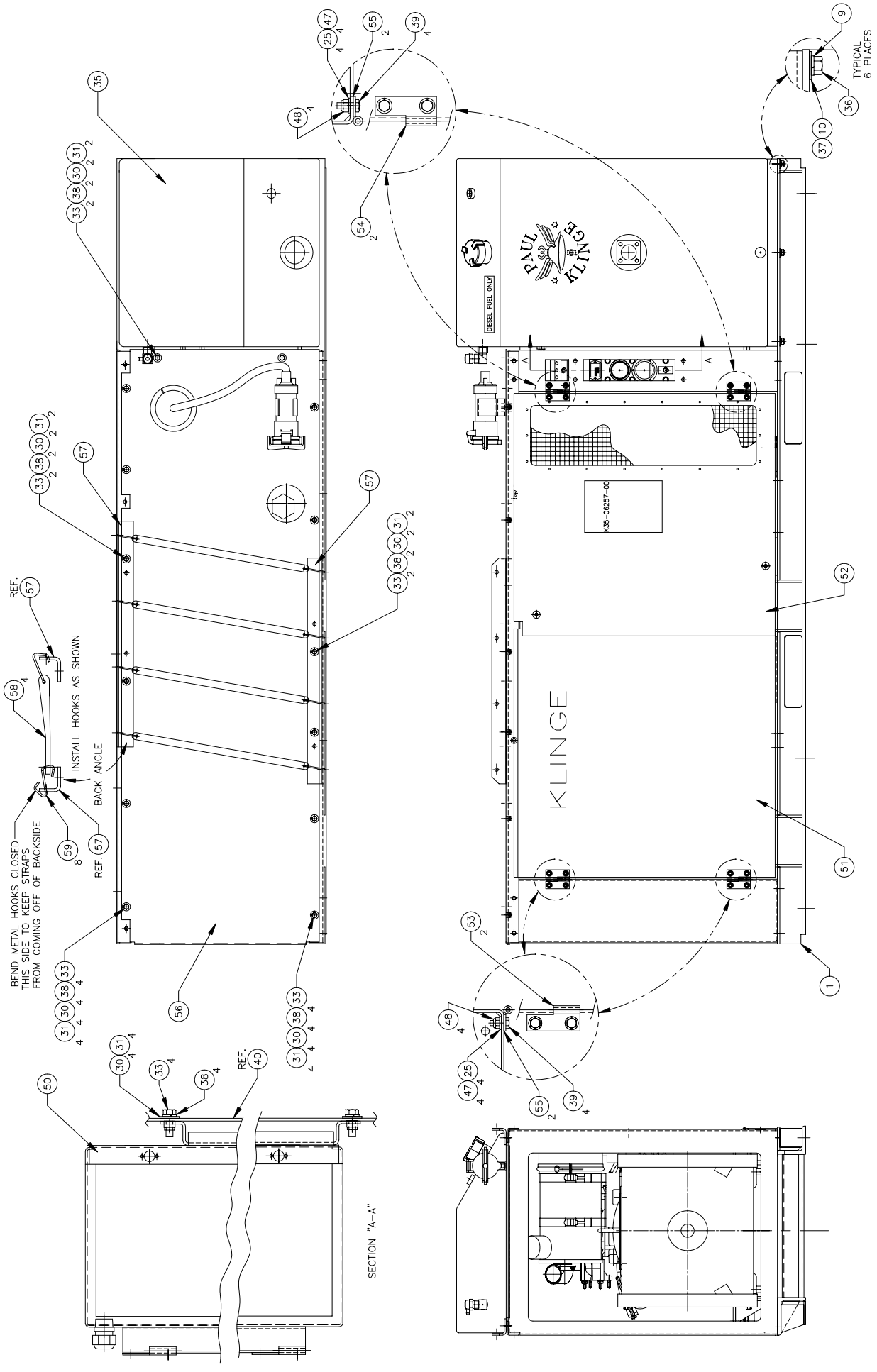
Fuel System Components	**56**
Electrical Box Assembly	**57-58**
Door Electrical Box	**59**
Final Assembly NMG-115-12	**60-63**
Marathon Electric Alternator Manual	**64-72**

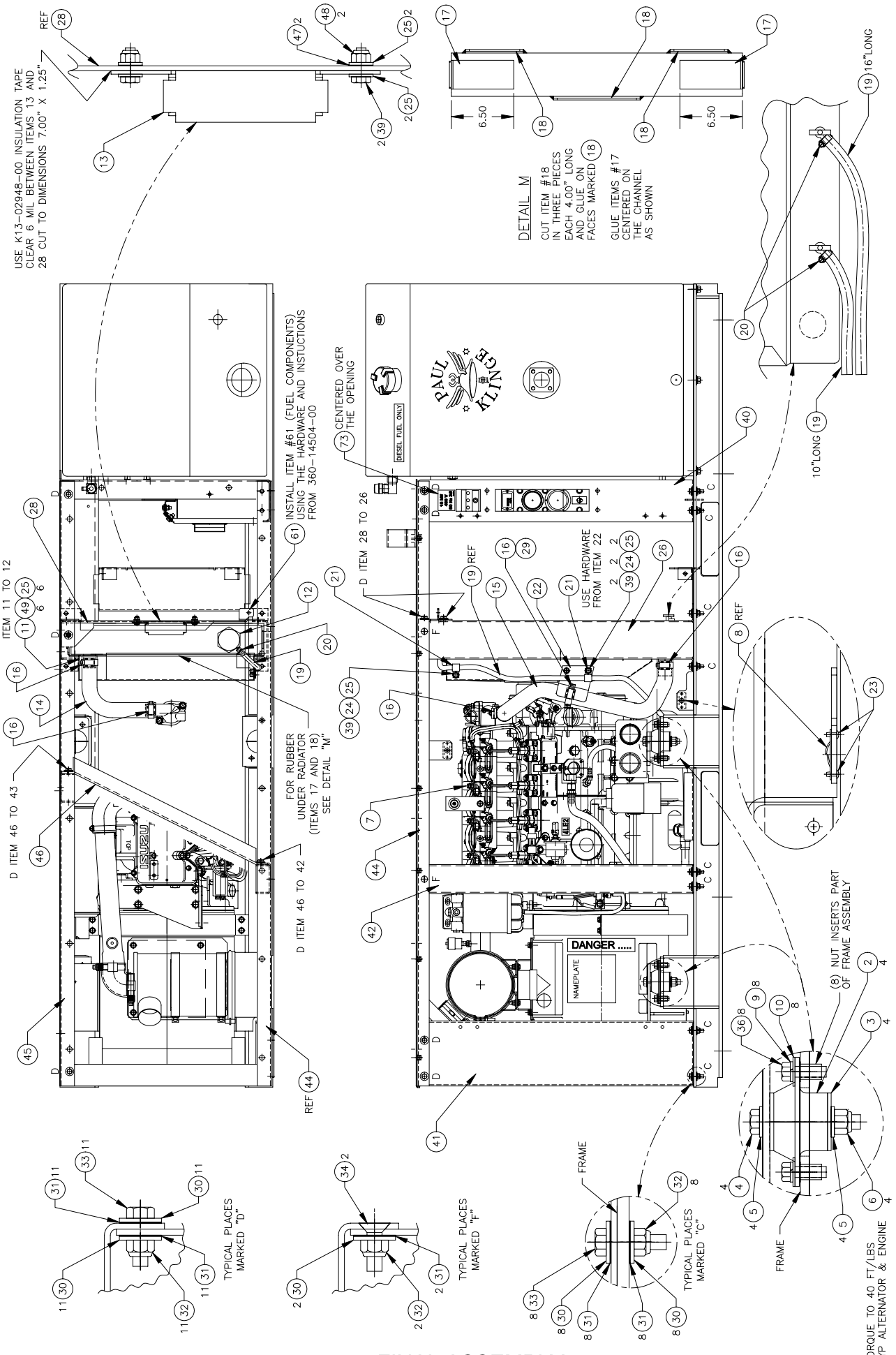
QTY	PART NO.	ITEM	DESCRIPTION
1	360-14361-00	1	FRAME ASSEMBLY NMG-115-10 COMPLETE
4	XB-999076	2	SHOCK MOUNT
4	XB-999077	3	WASHER SNUBBING
4	K21-16220-00	4	SCREW HEX SS 1/2-13 X 3.5
8	K21-16195-00	5	WASHER FLAT SS 1/2 1.06 O.D.
4	K21-14921-11	6	NUT LOCK SS 1/2-13
1	360-14355-01	7	ENGINE ALTERNATOR ASSEMBLY NMG-115-10 ISUZU / LIMA
8	K21-16180-00	8	RECEPTACLE SS SIZE 17 SCREW
14	K21-14069-00	9	WASHER LOCK SS 3/8 HEAVY 18-8
14	K21-14073-00	10	WASHER FLAT SS 3/8 0.44 I.D. 1.00 O.D. 0.083 THICK
1	360-14489-00	11	FAN SHROUD ASSEMBLY NMG-115-10
1	XB-340015	12	RADIATOR 4 ROW / 3 PASS
1	XB-205126	13	BRACKET ASSEMBLY RADIATOR HOLD-DOWN
1	XB-340024	14	HOSE RADIATOR INLET
1	XB-340025-01	15	HOSE RADIATOR OUTLET NMG-115-10
5	XB-999038	16	CLAMP HOSE SS RANGE 1-2"
2	XB-993011-03	17	RUBBER NEOPRENE 3/16 X 3 X 9"
1	XB-993000-05	18	RUBBER NEOPRENE 1/8 X 1 X 12"
40 IN.	XB-998090	19	TUBE PVC CLEAR 5/16 I.D.
3	K23-10280-00	20	CLAMP HOSE SS RANGE 0.38 - 0.63 5/16" WIDE
6	K21-15649-03	21	CLAMP CUSHIONED SS 1/2 I.D.
1	060-14473-00	22	HOLDER RADIATOR OUTLET HOSE
2	K21-13549-00	23	RIVET ALUM. 1/8 (18-25)
3	K21-10186-00	24	WASHER LOCK SPG SS 1/4 HEAVY 18-8
31	K21-10189-00	25	WASHER FLAT SS 1/4 0.63 O.D. 0.065 THK 18-8
1	060-14394-00	26	POST RADIATOR FRAME FRONT NMG-115-10
1	360-14529-00	27	POST ASSEMBLY RADIATOR FRAME REAR NMG-115-10
1	360-14398-00	28	ANGLE ASSEMBLY RADIATOR TOP SUPPORT NMG-115-10
26 IN.	XB-998188	29	TUBING PVC CLEAR 7/16 I.D. X 9/16 O.D.
87	K21-14072-00	30	WASHER FLAT SS 5/16 0.38 I.D. 0.88 O.D. 0.083 THICK
84	K21-50492-04	31	WASHER INSULATING PVC 5/16 (0.88 O.D. X 0.020 THICK)
28	K21-14921-07	32	NUT LOCK SS 5/16-18
48	K21-14059-00	33	SCREW HEX SS 5/16-18 X 1.00"
2	K21-16395-04	34	SCREW FLAT SS 5/16-18 X 1.00" SLOT
1	360-14500-00	35	TANK ASSEMBLY FUEL NMG-115-10
14	K21-14972-00	36	SCREW HEX SS 3/8-16 X 1.25"
6	K21-50492-05	37	WASHER INSULATING PVC 3/8 (1.00 O.D. X 0.020 THICK)
29	K21-14761-00	38	WASHER LOCK SS 5/16 HEAVY 18-8

QTY	PART NO.	ITEM	DESCRIPTION
18	K21-14057-00	39	SCREW HEX SS 1/4-20 X 3/4"
1	360-14363-00	40	PANEL ASSEMBLY TANK END NMG-115-10
1	360-14491-00	41	PANEL ALTERNATOR END WEDED & PAINTED WHITE NMG-115-10
1	060-14512-00	42	POST FRAME FRONT WELDED & PAINTED WHITE
1	360-14530-00	43	POST ASSEMBLY FRAME REAR NMG-115-10
1	360-14399-00	44	ANGLE ASSEMBLY TOP FRONT NMG-115-10
1	360-14376-00	45	ANGLE ASSEMBLY TOP REAR NMG-115-10
1	060-14482-00	46	ANGLE DIAGONAL SUPPORT TOP PLATE NMG-115-10
15	K21-50492-03	47	WASHER INSULATING PVC 1/4 (0.62 O.D. X 0.020 THICK)
15	K21-14921-05	48	NUT LOCK SS 1/4-20
6	K21-14642-00	49	SCREW HEX SS 1/4-20 X 1/2"
1	360-14374 00	50	BOX ASSEMBLY ELECTRICAL FULLY WIRED NMG-115-10
1	360-14475-00	51	DOOR ASSEMBLY LEFT - ALTERNATOR END NMG-115-10
1	360-14477-00	52	DOOR ASSEMBLY RIGHT - ENGINE END NMG-115-10
2	K29-17880-01	53	HINGE SLIP SS 9/32 HOLE SOCKET LEFT HAND
2	K29-17879-01	54	HINGE SLIP SS 9/32 HOLE SOCKET RIGHT HAND
4	060-09113-00	55	INSULATOR HINGE
1	360-14494-00	56	PANEL ASSEMBLY TOP NMG-115-10
2	060-14492-00	57	RETAINER POWER CABLE NMG-115-10
4	K28-10691-00	58	STRAP 15" LONG NO HOOKS
8	K29-18490-00	59	HOOK STRAP SS ø0.125 WIRE
1	360-14495-00	60	PANEL ASSEMBLY REAR NMG-115-10
1	360-14504-00	61	FUEL SYSTEM COMPONENTS NMG-115-10
1	K25-25912-00	62	BATTERY 12 VOLT 3/8-16 STUDS - 625 CCA
2	K25-25927-00	63	NUT BATTERY SEALING 3/8-16
1	360-14506-01	64	BATTERY CABLE POSITIVE (+) NMG-115-10
1	360-14506-02	65	BATTERY CABLE NEGATIVE (-) NMG-115-10
1	060-14493-00	66	ANGLE SS BATTERY HOLD-DOWN
2	XB-209049	67	ROD BATTERY HOLD-DOWN
2	XB-993011-02	68	RUBBER NEOPRENE 3/16 X 3 X 12"
1	XB-993011-22	69	RUBBER NEOPRENE 3/16 X 2 X 8.5"
1	XB-998077	70	CLAMP CABLE CS VINYL COATED 0.81 I.D. 0.406 MTG. HOLE
1	K21-15649-08	71	CLAMP CUSHIONED SS 3/4" I.D. 0.28 MTG. HOLE
7	K21-14730-00	72	SCREW HEX SS 5/16-18 X 1.25"
1	K35-06266-00	73	LABEL 15KW 480V 60HZ 3ø

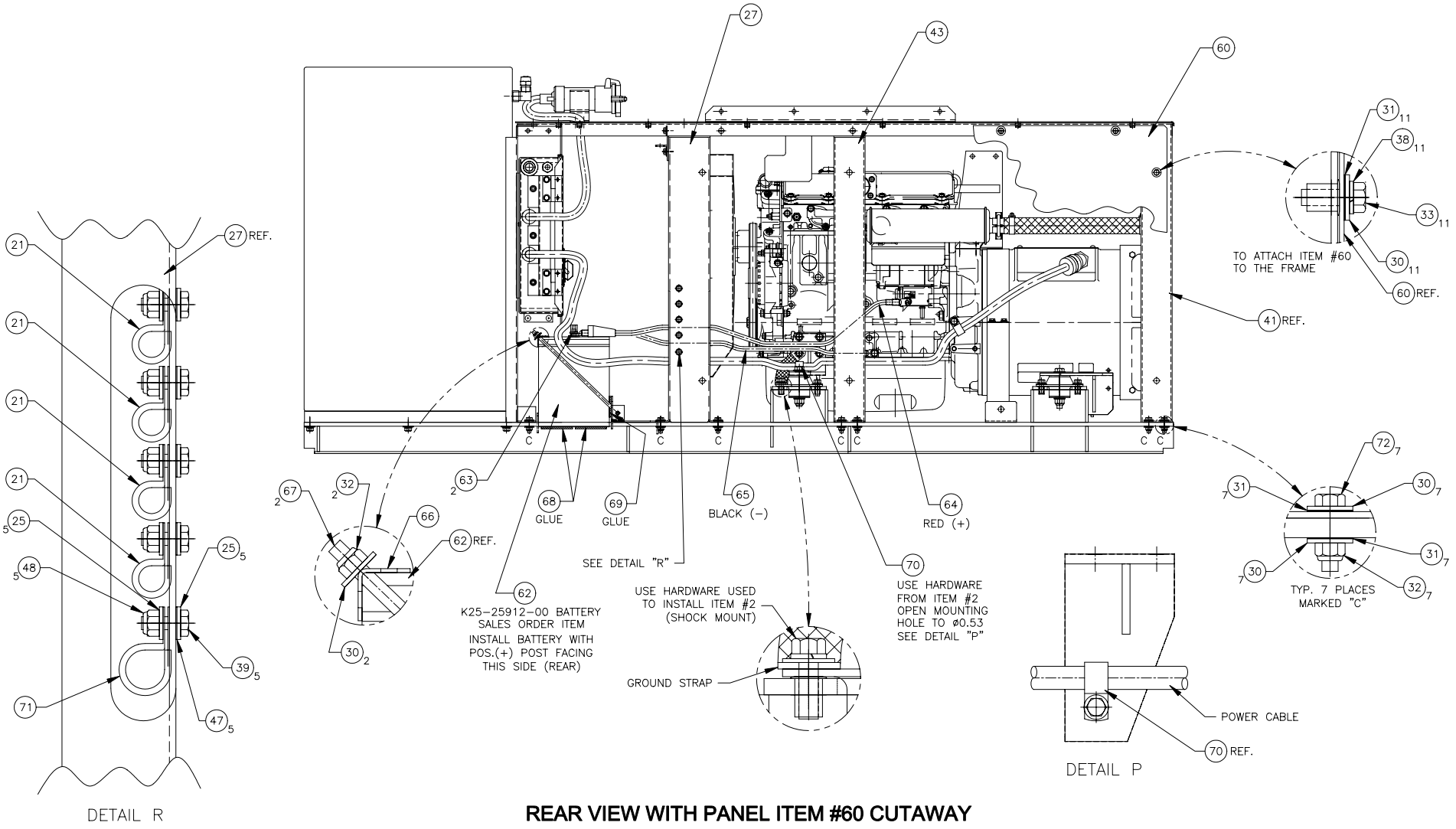
NOTES:
1. FOR CLARITY NOT ALL DETAILS ARE SHOWN IN THE DIFFERENT VIEWS.
2. INSTALL ITEM #61 (FUEL SYSTEM COMPONENTS) USING THE HARDWARE AND INSTRUCTIONS FROM 360-14504-00.



FINAL ASSEMBLY



FINAL ASSEMBLY



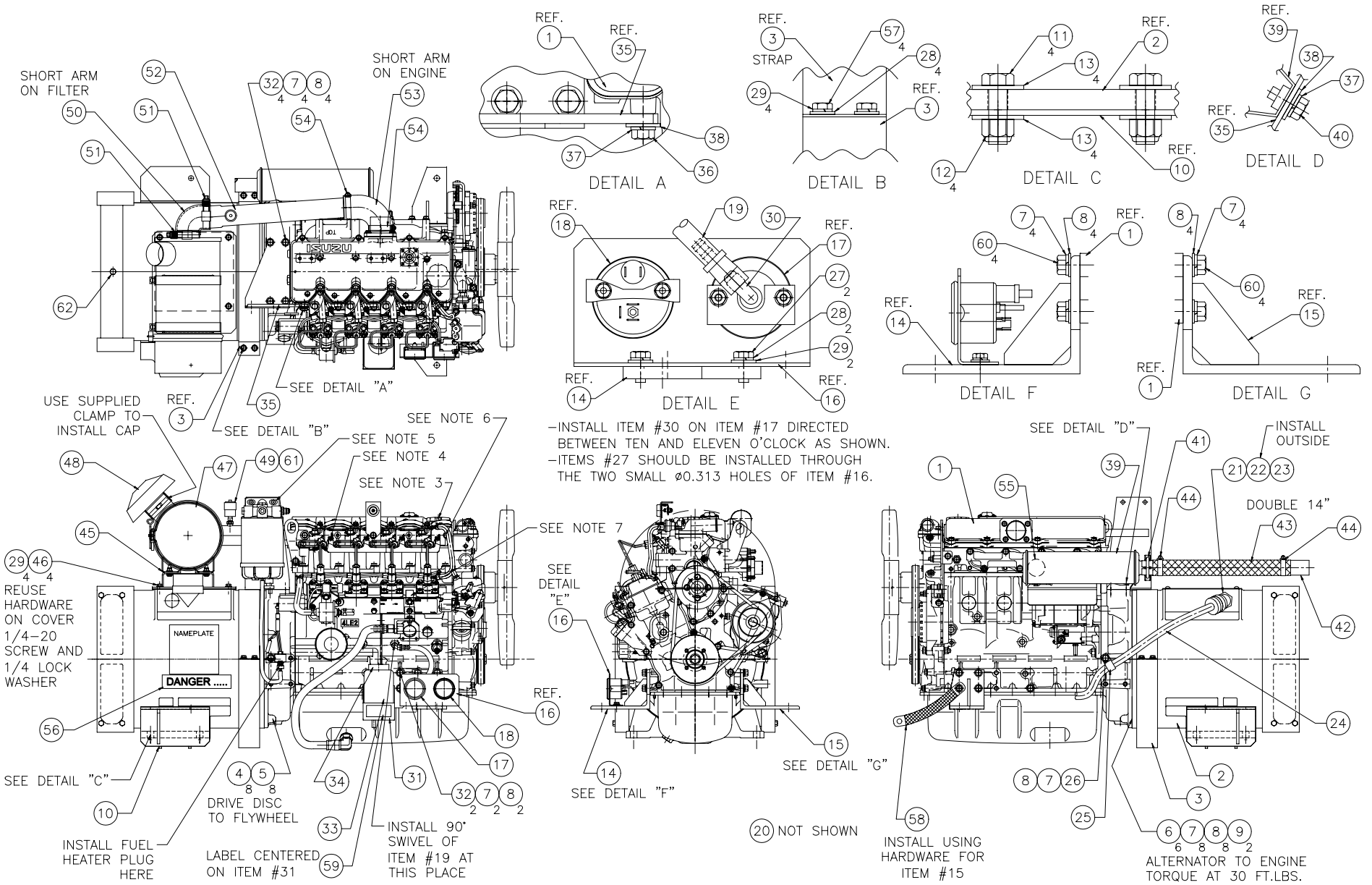
REAR VIEW WITH PANEL ITEM #60 CUTAWAY

QTY	PART NO.	ITEM	DESCRIPTION
1	360-14515-01	1	ENGINE DIESEL ISUZU 4LE2PV-01 MODIFIED FOR NMG-115-10 USE
1	XB-997878	2	ALTERNATOR LIMA MAC 480V / 60Hz SAE #5 C 107 G .36
1	XB-997879	3	BAFFLE AIR EXHAUST ALTERNATOR
8	XB-992659-16	4	SCREW CAP SOCKET M8 X 16MM DIN 912 CLS 12.9
8	XB-992749	5	WASHER FLAT M8 HIGH STRENGTH PLATED STEEL
6	XB-992610-30	6	BOLT HEX HD M10 X 30MM DIN 933 8.8 PLATED
23	XB-992732	7	WASHER LOCK SPG M10 SS 18-8 DIN 127B
23	K21-50401-10	8	WASHER FLAT SS M10 10.5 X 20 X 2 18-8
2	K21-16249-10	9	NUT HEX SS M10 X 1.5
1	360-13800-00	10	CRADLE LIMA ALTERNATOR WELDMENT BLACK
4	K21-15994-00	11	SCREW HEX SS 5/8-11 X 2
4	K21-14921-13	12	NUT LOCK SS 5/8-11
8	K21-16254-00	13	WASHER FLAT SS 5/8 0.66 I.D. X 1.31 O.D. X 0.095 THK
1	360-14353-00	14	MOUNT ASSEMBLY ENGINE RIGHT NMG-115-10
1	360-14354-00	15	MOUNT ASSEMBLY ENGINE LEFT NMG-115-10
1	XB-340013	16	BRACKET PRESSURE & TEMPERATURE GAUGES
1	XB-994020	17	GAUGE OIL PRESSURE
1	XB-994130	18	GAUGE TEMPERATURE
1	XB-216562-10	19	HOSE OIL PRESSURE GAUGE
1	XB-540076 REV.B	20	WIRE HARNESS ENGINE ISUZU W. 20 AMP BATT. CHARGER ALTERN.
1	XB-994098-03	21	CABLE GRIP ALUMINUM 1.00" NPT 45°
1	K25-13609-00	22	RING SEAL CS 1.00" CND
1	XB-994006-03	23	NUT LOCK 1.00"
1	360-14507-00	24	CABLE ASSEMBLY POWER ALTERNATOR TO CONTROL BOX
1	XB-998077	25	CLAMP CABLE PARKER CL-14 0.81 I.D.
1	K21-50226-25	26	SCREW HEX SS M10 X 1.5 X 25
2	K21-13579-00	27	SCREW HEX SS 1/4-20 X 5/8
6	K21-10186-00	28	WASHER LOCK SPG SS 1/4 HEAVY 18-8
10	K21-10189-00	29	WASHER FLAT SS 1/4 0.63 O.D. 0.065 THK 18-8
1	XB-998070-02	30	FITTING ELBOW BRASS 1/8 FPT X 7/16-20

QTY	PART NO.	ITEM	DESCRIPTION
1	360-14381-00	31	SUPPORT OVERFLOW BOTTLE ASSEMBLY NMG-115-10
6	K21-50226-20	32	SCREW HEX SS M10 X 1.5 X 20
1	XB-999093	33	BOTTLE OVERFLOW COOLANT
1	XB-000094	34	CAP OVERFLOW BOTTLE
1	360-14390-00	35	SUPPORT ASSEMBLY MUFFLER & FUEL FILTER
1	K21-50225-20	36	SCREW HEX SS M8 X 1.25 X 20
2	K21-14761-00	37	WASHER LOCK SPG SS 5/16 HEAVY 18-8
2	K21-14072-00	38	WASHER FLAT SS 5/16 0.38 I.D. X 0.88 O.D. X 0.083 THK
1	XB-999090	39	MUFFLER MODIFIED FROM XB-999090-01
1	K21-14360-00	40	SCREW HEX SS 5/16-18 X 3/4 LG
1	XB-998190	41	CLAMP EXHAUST CS 1-1/2"
1	060-14519-00	42	PIPE EXHAUST NMG-115-10
28 IN.	XB-995029	43	SLEEVING FIBERGLASS 1.50" I.D.
2	XB-999038	44	CLAMP HOSE SS RANGE 1-2"
1	360-14384-00	45	SUPPORT ASSEMBLY AIR FILTER & ALTERNATOR COVER NMG-115-10
4	K21-50492-03	46	WASHER INSULATING PVC 1/4 X 0.62 O.D.
1	K26-25091-02	47	FILTER AIR (K26-25091-00) 1 STAGE MODIFIED
1	K26-25095-04	48	HOOD AIR INLET PLASTIC STYLE E FITS 2.50 O.D. AIR FILTER INLET
1	K26-24666-00	49	INDICATOR AIR RESTRICTION 20" H20
1	K28-10838-00	50	ELBOW NEOPRENE 90° 2-1/4" SMALL RADIUS
2	K21-16379-09	51	CLAMP CONSTANT TORQUE SS 2-1/4
1	360-14385-00	52	PIPE ASSEMBLY AIR INTAKE NMG-115-10
1	060-14520-00	53	ELBOW RUBBER 2" I.D. X 90° AIR INTAKE NMG-115-10
2	XB-999057	54	CLAMP HOSE SS 1.56 - 2.50 RANGE
0.05	XB-999062	55	MUFFLER SEAL ACUSTA-SEAL
1	XB-302129	56	DECAL ALTERNATOR (MODIFIED LIMA)
4	K21-14057-00	57	SCREW HEX SS 1/4-20 X 3/4
1	XB-994022-08	58	STRAP GROUND 8" LONG 3/8" MOUNTING HOLE
1	XB-152043	59	DECAL USE 50/50 SOLUTION ETHYLENE GLYCOL/WATER
8	K21-50226-25	60	SCREW HEX SS M10 X 25
1	K26-24666-01	61	RESTRICTOR 1/8 FPT FOR AIR INDICATOR
1	K21-18433-00	62	SCREW HEX SS 3/8-16 X 3/4 LG

NOTES:

1. FOR CLARITY NOT ALL DETAILS ARE SHOWN IN THE DIFFERENT VIEWS.
2. ITEM #20 (ENGINE WIRE HARNESS) NOT SHOWN ON DRAWING. FOR WIRE HOOK-UP USE 360-14351-00.
3. USE EXISTING NYLON CLAMP TO GUIDE BLUE WIRE CONNECTED TO CONTROL RESISTOR.
4. USE EXISTING M4 BRASS SCREW TO ATTACH BLUE WIRE CONNECTING CONTROL RESISTOR WITH GLOW PLUGS LINE.
5. ATTACH TO ITEM #35 (SUPPORT ASSEMBLY MUFFLER & FUEL FILTER) ITEMS 13, 19, 20, & 21 FROM 360-14504-00 (FUEL SYSTEM COMPONENTS).
6. GROUND HERE ON EXISTING M8 SCREW 4 GREEN WIRES FROM ITEM #20 (WIRE HARNESS).
7. ATTACH ITEM #20 (WIRE HARNESS) HERE WITH EXISTING CLAMP.


SHORT ARM ON FILTER
SHORT ARM ON ENGINE
SEE DETAIL "A"
SEE DETAIL "B"
USE SUPPLIED CLAMP TO INSTALL CAP
REF.
DETAIL A
DETAIL B
DETAIL C
DETAIL D
DETAIL E
DETAIL F
DETAIL G
STRAP
–INSTALL ITEM #30 ON ITEM #17 DIRECTED BETWEEN TEN AND ELEVEN O'CLOCK AS SHOWN.
–ITEMS #27 SHOULD BE INSTALLED THROUGH THE TWO SMALL ø0.313 HOLES OF ITEM #16.
SEE NOTE 3
SEE NOTE 4
SEE NOTE 5
SEE NOTE 6
SEE NOTE 7
SEE DETAIL "C"
SEE DETAIL "D"
SEE DETAIL "E"
SEE DETAIL "F"
SEE DETAIL "G"
REUSE HARDWARE ON COVER 1/4–20 SCREW AND 1/4 LOCK WASHER
NAMEPLATE
DANGER .....
DRIVE DISC TO FLYWHEEL
INSTALL FUEL HEATER PLUG HERE
LABEL CENTERED ON ITEM #31
INSTALL 90° SWIVEL OF ITEM #19 AT THIS PLACE
INSTALL OUTSIDE
DOUBLE 14"
INSTALL USING HARDWARE FOR ITEM #15
ALTERNATOR TO ENGINE TORQUE AT 30 FT.LBS.
20 NOT SHOWN

QTY	PART NO.	ITEM	DESCRIPTION
1	K26-25145-03	1	ENGINE ISUZU 4LE2PV-01
1	K26-25145-102	2	FLYWHEEL HOUSING ISUZU SAE #5 80MM DEEP
1	K23-13332-07	3	FITTING 90° CS 7/8-14 37 FLARE / M20
1	XB-998200	4	FAN COOLING SUCTION ISUZU ø400MM 6 BLADE
1	XB-998207	5	SWITCH HIGH TEMP NO 221°F TRIP BODY GROUNDED
1	XB-998173	6	FITTING CS 1/8-28 BSPT MALE X 7/16-20 MALE
1	XB-998189	7	ADAPTER 3/8 NPTF X 3/8 BSPT
1	XB-994129	8	TEMPERATURE SENDER
1	360-14359-00	9	FLANGE EXHAUST ASSEMBLY NMG-115-10
1	XB-998217	10	GASKET EXHAUST FLANGE
4	XB-992908	11	NUT CS M8 X 1.25
4	XB-992708	12	WASHER LOCK CS M8
10	XB-992741	13	WASHER FLAT SS M8
1	XB-540049	14	SUPPORT CONTROL RESISTOR
1	XB-994131	15	CONTROL RESISTOR - DELIVERED WITH THE ENGINE
6	K21-50225-20	16	SCREW HEX SS M8 X 20
2	XB-992731	17	WASHER LOCK SS M8
1	360-14518-02	18	HOSE ASSEMBLY OIL DRAIN ISUZU 4LE2
1	XB-302169	19	BRACKET OIL DRAIN HOSE
1	XB-340041	20	BRACKET OIL DRAIN HOSE SUPPORT
-1	K21-16540-00	21	CAP NUT HEX CS M6
4	XB-992730	22	WASHER LOCK SPG SS M6
		23	
1	K21-14057-00	24	SCREW HEX SS 1/4-20 X 3/4 LG
1	K21-10186-00	25	WASHER LOCK SPG SS 1/4
1	060-06765-00	26	WASHER FLAT SS 1/4 X 1.00" O.D.
2	K21-50226-20	27	SCREW HEX SS M10 X 1.5 X 20
2	XB-992732	28	WASHER LOCK SPG SS M10
2	K21-50401-10	29	WASHER FLAT SS M10
1	K21-15649-04	30	CLAMP CUSH SS 5/8 I.D.
1	XB-998146	31	CLAMP CS VINYL CTD 1/2 I.D. X 3/4 W X 0.406 MTG HOLE
1	XB-998229	32	CLAMP 2-TUBE CUSHIONED 1/2"
1	360-14521-00	33	ADAPTER AIR INTAKE ISUZU 4LE2 ENGINE
1	XB-995021-02	34	CLAMP CABLE NYL 1/4" X 0.17 MTG HOLE WHITE
4	K21-16363-25	35	SCREW HEX CS M6 X 1 X 25 LONG
1	K21-50103-06	36	NUT HEX SS M6 X 1
4	K21-16506-06	37	WASHER FLAT CS M6
2	K21-16507-125	38	STUD BS M10 X 1.5 X 125mm LONG GR5
1	060-14351-00	39	SHIELD STARTER MOTOR 4LE1/2 PV ENGINE

NOTES:

1. REMOVE EXISTING 100MM FLYWHEEL HOUSING AND RETURN TO STOCK AS K26-25145-101.
2. REMOVE THE TWO EXISTING M10 X 145 STUDS AND RETURN THEM TO STOCK AS K26-25145-109.
3. REMOVE EXISTING BLOWER FAN AND RETURN TO STOCK AS K26-25145-104.
4. REMOVE EXISTING 2 POLE TEMPERATURE SWITCH AND RETURN TO STOCK AS K26-15145-03.
5. REMOVE EXISTING PLUG 1/8-28 BSPT AND RETURN TO STOCK AS XB-998174.
6. REMOVE EXISTING PLUG 3/8 BSPT AND RETURN TO STOCK AS XB-998189-03.
7. INSTALL FAN USING ONLY THE 4.5MM STEEL FAN SPACER. RETURN THE 18MM ALUMINUM FAN SPACER TO STOCK AS K26-25145-105.
8. REMOVE THE SECONDARY FUEL FILTER ASSEMBLY INCLUDING THE MOUNTING BRACKET WITH HARDWARE AND HOSE CONNECTING TO FUEL PUMP; AND RETURN THESE ITEMS TO STOCK AS K26-25145-108.
9. REMOVE THE 90° ELBOW ON THE AIR INTAKE MANIFOLD INCLUDING THE TWO 6MM STUDS AND NUTS; AND RETURN ALL TO STOCK AS K26-25145-110.
10. REMOVE EXISTING M6 CAP NUT AND REPLACE IT WITH A REGULAR SS M6 HEX NUT (ITEM #36). RETURN CAP NUT TO INVENTORY AS K21-16540-00.

REV LEV	DATE	CHG NO	DR	CHK	REVISION RECORD
A	2/09/06	N/A	DBG	DB	ADDED ITEM #39
B	5/11/06	N/A	DBG	DB	ITEM #13 QTY. 10 WAS QTY. 6
	ITEM #16 (K21-50225-20) QTY. 6 WAS (XB-992608-20) QTY.2				
	ITEM #22 QTY. 5 WAS QTY. 1, DELETED ITEM #36				
C	12/04/06	N/A	DBG	DB	ITEM #1 WAS K26-25145-00
D	6/08/06	N/A	DBG	DB	ADDED ITEMS #21, AND 36
	DELETED ITEM #23, ITEM #22 QTY 4 WAS 5, ITEM #34 WAS XB-998229				

REV LEV	DATE	CHG NO	DR	CHK	REVISION RECORD

ALL PROPRIETARY RIGHTS IN THE SUBJECT MATTER HEREOF ARE RESERVED, AND NO PERMISSION IS GRANTED TO REPRODUCE THIS PRINT IN WHOLE OR IN PART, OR DISCLOSE ANY OF THE INFORMATION UPON IT TO OTHERS WITHOUT WRITTEN RELEASE BY KLINGE CORP.

PROJECTION

DIMENSIONS ARE IN INCHES (MM)
DO NOT SCALE — TOLERANCES UNLESS OTHERWISE INDICATED
XX DECIMAL +/-.03 OR [1/32]
XXX DECIMAL +/-.015 OR [1/64]

	NAME	DATE
DR	D GROVE	11/02/05
APPR	DB	11/02/05
SCALE	N/A	

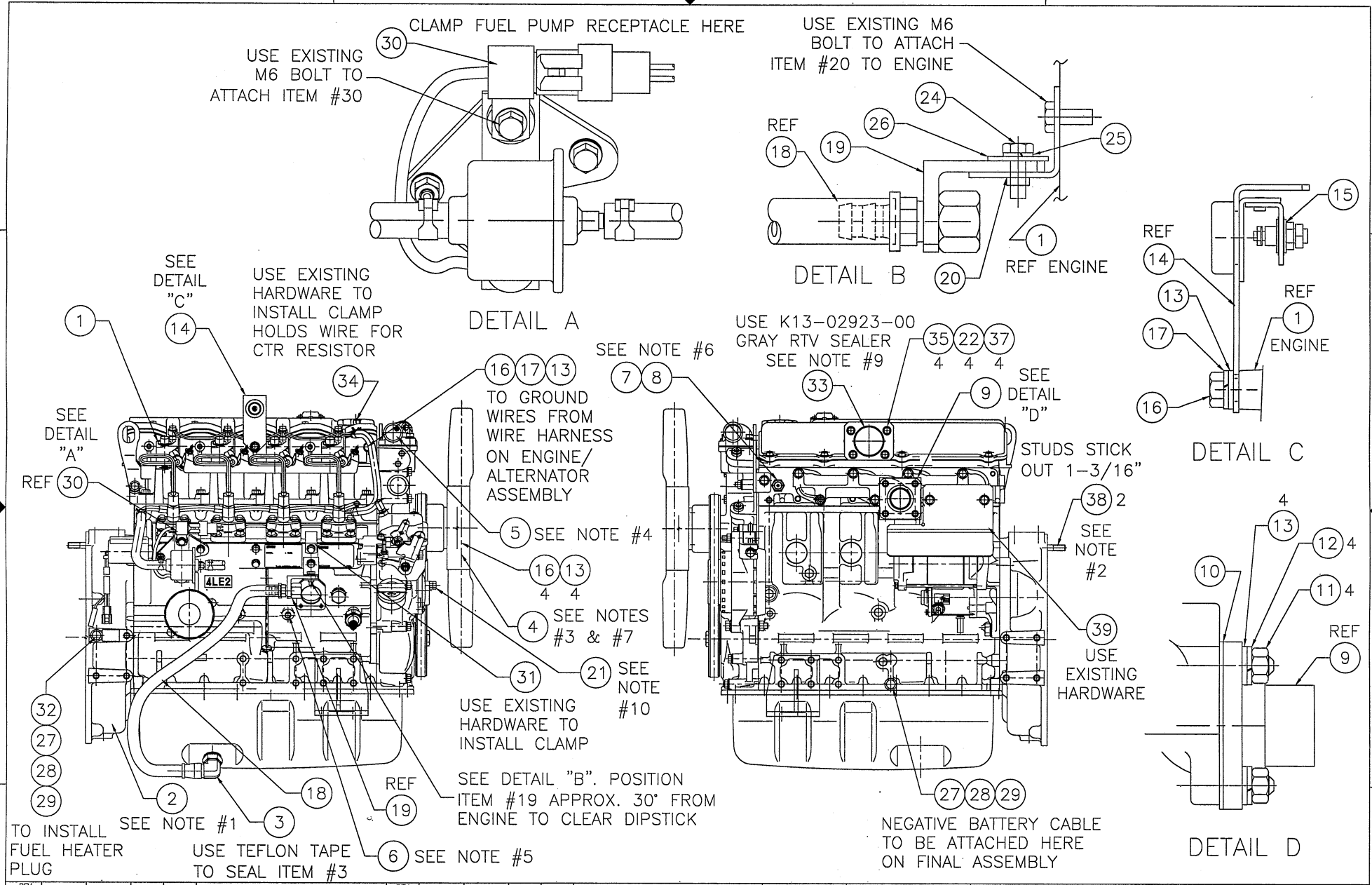
ENGINE
DIESEL ISUZU 4LE2PV-01
MODIFIED FOR
NMG-115-10 USE

KLINGE CORPORATION
York, Pennsylvania USA
Marine Container Refrigeration Equipment

MATERIAL
MATL NO N/A
DESCR N/A
SIZE N/A

DWG NO 360-14515-01
REV D
SH NO 1 OF 2
DWG SIZE C

360-14515-01 1/2



REV LEV	DATE	CHG NO	DR	CHK	REVISION RECORD
A	2/09/06	N/A	DBG	DB	ADDED ITEM #39
B	5/10/06	N/A	DBG	DB	CHANGED LOCATION OF ITEM #20
	ITEM #22 QTY 4 WAS ITEM #36 QTY 4, ADDED ITEM #13 QTY. 4 AND				
	ITEM #16 QTY. 4 TO FAN				
C	12/04/06	N/A	DBG	DB	SEE SHEET 1 FOR REV. CHANGE
D	6/08/07	N/A	DBG	DB	ADDED ITEM #21 AND NOTE
	DELETED ITEM #23, DELEDED ITEM #22 IN DETAIL B (SEE HISTORY FILE)				

REV LEV	DATE	CHG NO	DR	CHK	REVISION RECORD

ALL PROPRIETARY RIGHTS IN THE SUBJECT MATTER HEREOF ARE RESERVED, AND NO PERMISSION IS GRANTED TO REPRODUCE THIS PRINT IN WHOLE OR IN PART, OR DISCLOSE ANY OF THE INFORMATION UPON IT TO OTHERS WITHOUT WRITTEN RELEASE BY KLINGE CORP.

PROJECTION

DIMENSIONS ARE IN INCHES (MM)
DO NOT SCALE — TOLERANCES UNLESS OTHERWISE INDICATED
XX DECIMAL +/-.03 OR [1/32]
XXX DECIMAL +/-.015 OR [1/64]

	NAME	DATE
DR	D GROVE	11/02/05
APPR	DB	11/02/05
SCALE	N/A	

ENGINE
DIESEL ISUZU 4LE2PV-01
MODIFIED FOR
NMG-115-10 USE

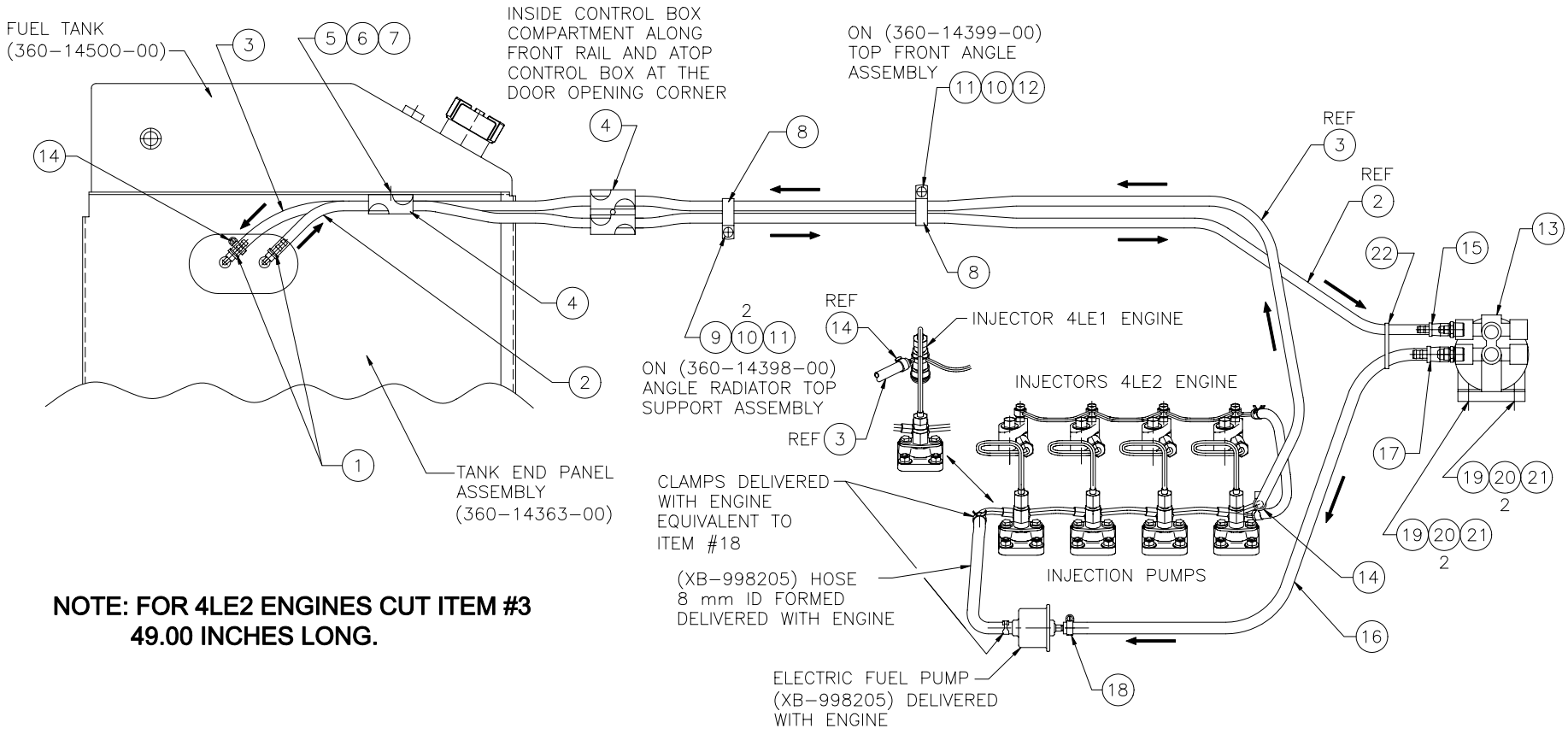
KLINGE CORPORATION
York, Pennsylvania USA
Marine Container Refrigeration Equipment

MATERIAL
MATL NO N/A
DESCR N/A
SIZE N/A

DWG NO 360-14515-01
REV D
SH NO 2 OF 2
DWG SIZE C

360-14515-01 2/2

QTY	PART NO.	ITEM	DESCRIPTION	QTY	PART NO.	ITEM	DESCRIPTION
2	K23-13362-01	1	SWIVEL BARB 90° JIC 7/16-20 FOR 1/4"ID HOSE	1	K21-16398-03	12	SCREW FLAT HEAD SS 1/4-20 X 3/4"
1	060-14503-01	2	HOSE 1/4"ID X 51" LG FUEL TANK OUT	1	360-14505-00	13	FUEL FILTER AND HEATER ASSEMBLY NMG-115-10
1	060 14503-02	3	HOSE 5/16"ID X 57" LG FUEL TANK RETURN	2	K23-10280-00	14	CLAMP HOSE .38-.63 5/16 WIDE
2	XB-998170	4	HOSE CLIP 2 X 1/2"OD PLASTIC	1	K23-13038-01	15	FITTING STR 1/4" HOSE X 7/16-20 F FLR BRASS
1	XB-991434-10	5	SCREW FLAT HEAD SS #8-32 X 1-1/4"	1	060-14503-03	16	HOSE 3/8" ID X 18" LG
1	K21-16245-00	6	WASHER FLAT SS #8 0.188 ID X 0.38 OD	1	K23-13038-03	17	FITTING STR 3/8" HOSE X 5/8-18 F FLR BRASS
1	K21-14921-02	7	NUT LOCK SS 1/4-20	1	K21-16218-00	18	CLAMP HOSE SS .38 - .88
2	K21-15649-05	8	CLAMP CUSHIONED SS 7/8" ID	2	K21-14730-00	19	SCREW HEX SS 5/16-18 X 1-1/4" LG
1	K21-14057-00	9	SCREW HEX SS 1/4-20 X 3/4	4	K21-14072-00	20	WASHER FLAT SS 5/16 .38 ID .88 OD
3	K21-10189-00	10	WASHER FLAT SS 1/4"	2	K21-14921-07	21	NUT LOCK SS 5/16-18
2	K21-14921-05	11	NUT LOCK SS 1/4-20	1	K25-23765-02	22	STRAP PLASTIC BLACK .19 W X 7.4" LONG



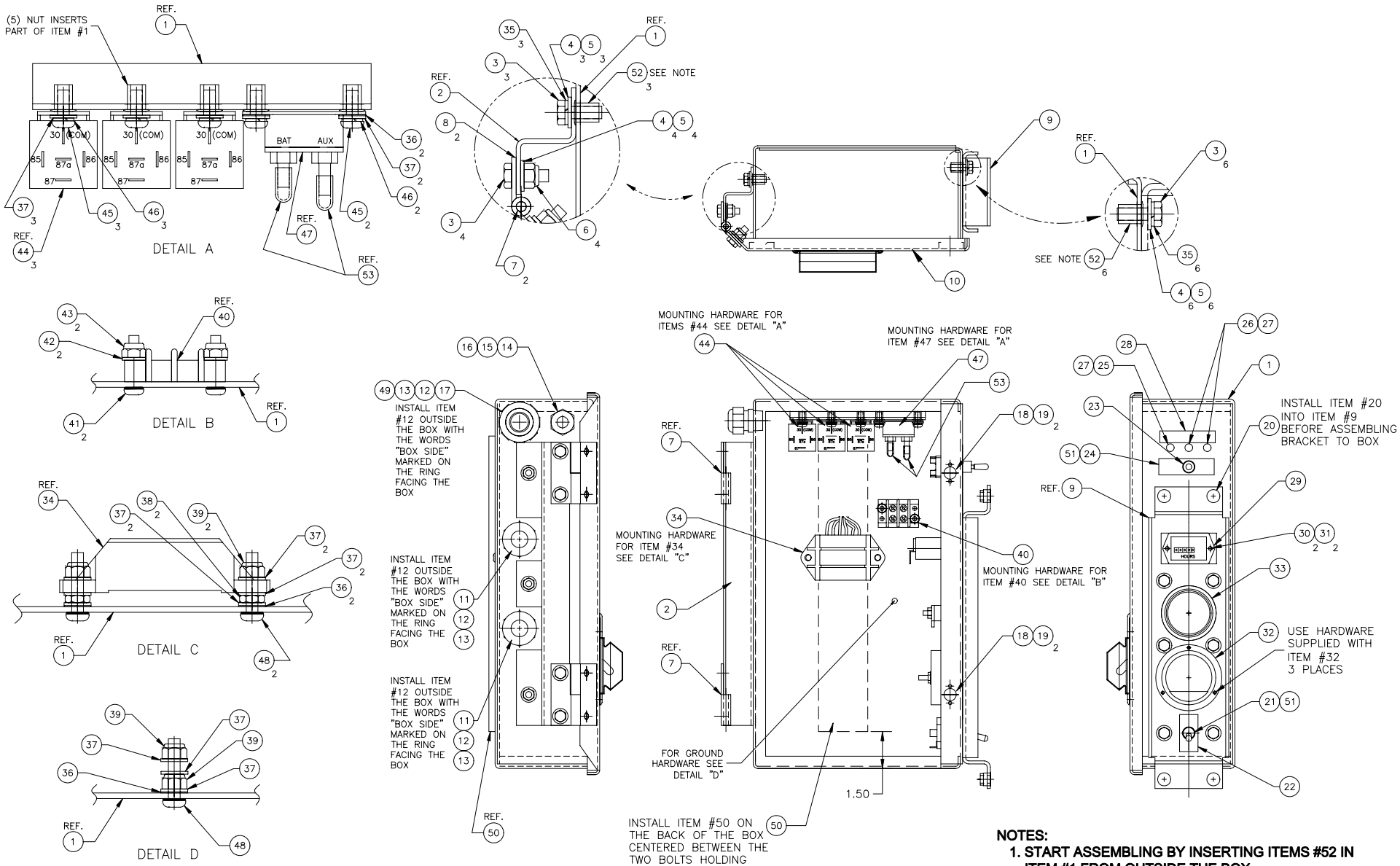
NOTE: FOR 4LE2 ENGINES CUT ITEM #3 49.00 INCHES LONG.

ELECTRICAL BOX ASSEMBLY

QTY	PART NO.	ITEM	DESCRIPTION
1	360-14365-00	1	BOX ELECT NMG-115-10 WELD & PAINT WHT
1	060-11754-01	2	SUPPORT HINGE ELECTRICAL BOX
13	K21-14057-00	3	SCREW HEX SS 1/4-20 X 3/4
13	K21-10189-00	4	WASHER FLAT SS 1/4
13	K21-50492-03	5	WASHER INSULATOR 1/4
4	K21-14921-05	6	NUT LK SS 1/4-20
2	K29-17879-01	7	HINGE SLIP SS 9/32 HOLES SOCKET
2	060 09113-00	8	INSULATOR HINGE
1	060-11755-01	9	CHANNEL ELECT BOX W/ HI VOLTAGE VOLTME
1	360-14372-00	10	DOOR ASSEMBLY ELECT BOX NMG-115-10
2	XB-994000-02	11	CABLE GRIP 3/4"
3	K25-22534-02	12	RING SEAL SS 3/4 CND
3	XB-994006-02	13	NUT LOCK 3/4 PLATED STEEL
1	K25-26129-03	14	CONNECTOR STRAIGHT PLASTIC SHT 1/2
1	K25-26147-01	15	RING SEAL PLASTIC 1/2
1	K25-26340-02	16	NUT LOCK PLASTIC 1/2
1	XB-994070-02	17	CABLE CONNECTOR 3/4" PLASTIC
2	K21-14682-00	18	RECPT FASTENER #12 SCR RIVET TY SS
4	K21-15376-00	19	RIVET SST 1/8 DOME HD
4	K21-16445-11	20	NUT INSERT LF CBRS 5/16-18
1	XB-994040	21	SWITCH ON/ OFF
1	K35-06253-01	22	LABEL ON-OFF ELECTRICAL BOX
1	XB-994042	23	SWITCH PREHEAT/ START
1	K35-06253-03	24	LABEL PREHEAT/ START
1	K25-26330-11	25	LAMP INDICATOR GREEN 12 VDC
2	K25-26330-13	26	LAMP INDICATOR RED 12 VDC
3	K28-10995-010	27	RING "O" EPDM .25 ID X .06 SECT

QTY	PART NO.	ITEM	DESCRIPTION
1	K35-06253-02	28	LABEL SYS ON/ LOW OIL PRESS/ HIGH TEMP
1	K25-22099-00	29	HOURMETER
2	K21-14921-01	30	NUT LOCK SS #6-32
2	K21-15697-00	31	SCREW PAN SS #6-32 X 1/2
1	XB-994003	32	VOLTMETER 0-600 VAC
1	XB-994001	33	AMPMETER -50 0 +50 AMP
1	XB-994158	34	TIMER TEMP & OIL PRESSURE SHUTDOWN
9	K21-10188-00	35	WASHER LOCK SPG SS 1/4
5	K21-50492-02	36	WASHER INSULATOR #10
14	K21-12574-00	37	WASHER FLAT SS #10
2	XB-992103	38	NUT HEX SS #10-32 THIN
4	K21-14921-03	39	NUT LOCK SS #10-32
1	K25-21619-02	40	BLOCK TERMINAL 6-32 2 POLE
2	K21-16504-04	41	SCREW SELF SEALING PAN SS #8-32 X 3/4
2	K21-16245-00	42	WASHER FLAT SS #8
2	K21-14921-02	43	NUT LOCK SS #8-32
3	K24-22121-00	44	RELAY SPDT 12 VDC COIL 30 A
5	K21-15742-00	45	SCREW PAN SS #10-32 X 1/2
5	K21-08206-00	46	WASHER LOCK SPG SS #10
1	XB-994008	47	CIRCUIT BREAKER 25 A 12 VDC
3	K21-16505-05	48	SCREW SELF SEALING PAN SS #10-32 X 1
2.5 FT	XB-994111	49	FLEX CONDUIT PLASTIC BLACK 3/4
1	XB-993011-20	50	RUBBER NEOPRENE 1/4 X 2 X 12"
2	K24-17239-00	51	BOOT TOGGLE SWITCH
9	K21-16445-09	52	NUT INSERT LF CBRS 1/4-20
2	XB-993019	53	SCREW PROTECTOR #10 PLASTIC
2	K28-05007-00	54	CAP/ PLUG SEAL #5 C = 0.409

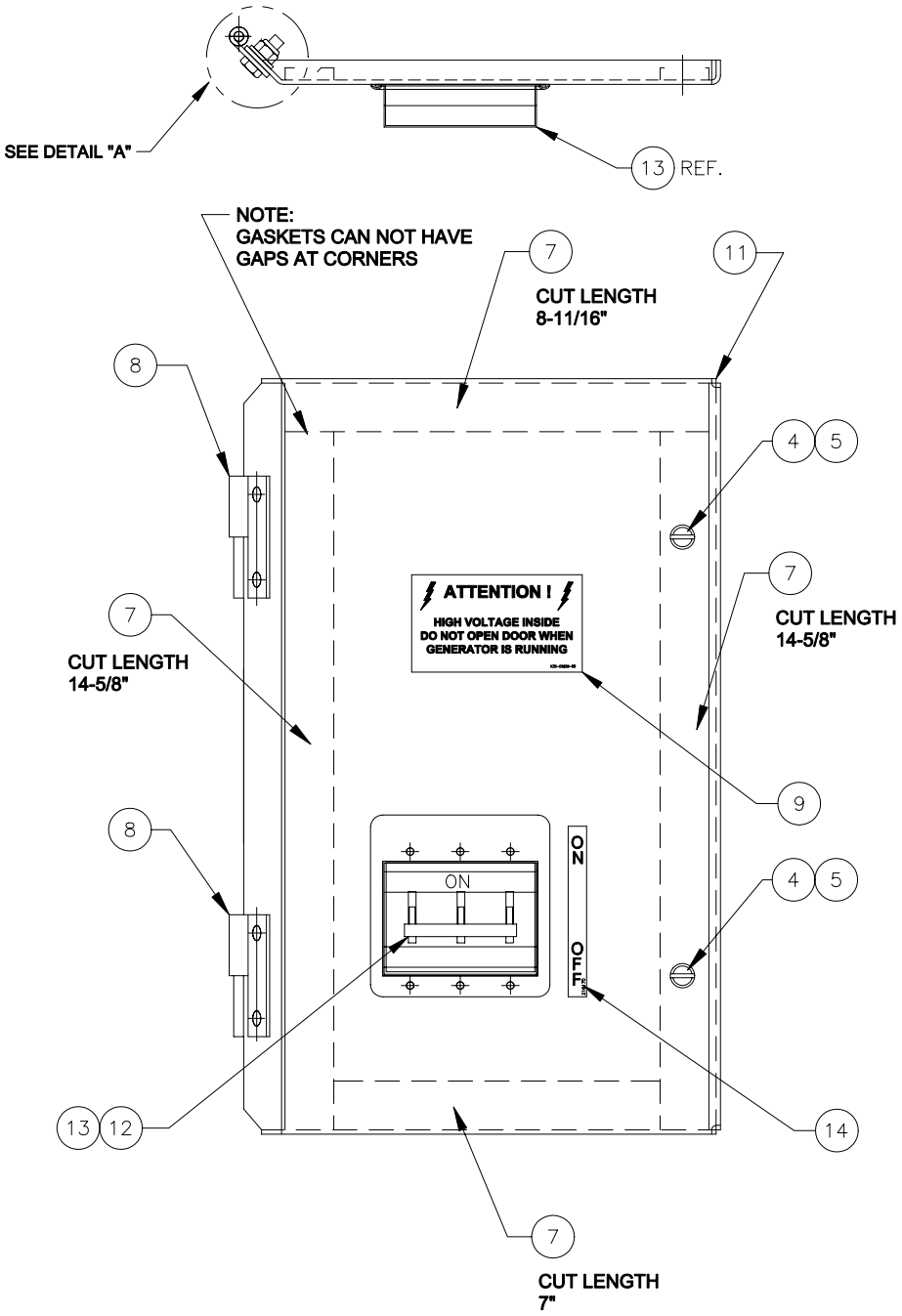
ELECTRICAL BOX ASSEMBLY


(5) NUT INSERTS PART OF ITEM #1
REF.
DETAIL A
DETAIL B
DETAIL C
DETAIL D
SEE NOTE
INSTALL ITEM #12 OUTSIDE THE BOX WITH THE WORDS "BOX SIDE" MARKED ON THE RING FACING THE BOX
MOUNTING HARDWARE FOR ITEMS #44 SEE DETAIL "A"
MOUNTING HARDWARE FOR ITEM #47 SEE DETAIL "A"
MOUNTING HARDWARE FOR ITEM #34 SEE DETAIL "C"
MOUNTING HARDWARE FOR ITEM #40 SEE DETAIL "B"
FOR GROUND HARDWARE SEE DETAIL "D"
INSTALL ITEM #50 ON THE BACK OF THE BOX CENTERED BETWEEN THE TWO BOLTS HOLDING ITEM #34
1.50
INSTALL ITEM #20 INTO ITEM #9 BEFORE ASSEMBLING BRACKET TO BOX
USE HARDWARE SUPPLIED WITH ITEM #32 3 PLACES

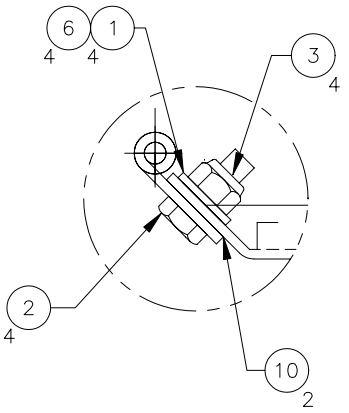
NOTES:

1. **START ASSEMBLING BY INSERTING ITEMS #52 IN ITEM #1 FROM OUTSIDE THE BOX.**
2. **INSTALL ITEMS #54 ON WIRE STUDS OF ITEM #32.**

DOOR ELECTRICAL BOX



QTY	PART NO.	ITEM	DESCRIPTION
4	K21-10189-00	1	WASHER FLAT SS 1/4
4	K21-14057-00	2	SCR HEX SS 1/4-20 X 3/4
4	K21-14921-05	3	NUT LOCK SS 1/4-20
2	K21-15393-00	4	WASHER RETAINING SS #12
2	K21-16316-00	5	SCR CAPTIVE SS 12 SLOT .15-.50
4	K21-50492-03	6	WASHER INSULATED 1/4
4 FT	K28-10295-00	7	STRIP SPONGE 1/4 X 1 CLS CELL
2	K29-17879-02	8	HINGE SLIPE SS 9/32 HOLES W/PIN
1	K35-06259-00	9	LABEL "ATTENTION HIGH VOLTAGE..."
2	060-09113-00	10	INSULATOR HINGE
1	060-14371-00	11	DOOR ELECTRICAL BOX NMG-115-10
1	K24-22098-00	12	CIRCUIT BREAKER 25A 3 POLE
1	K28-10785-00	13	SHIELD CIRCUIT BREAKER KIT
1	XB-216170	14	DECAL "ON-OFF"

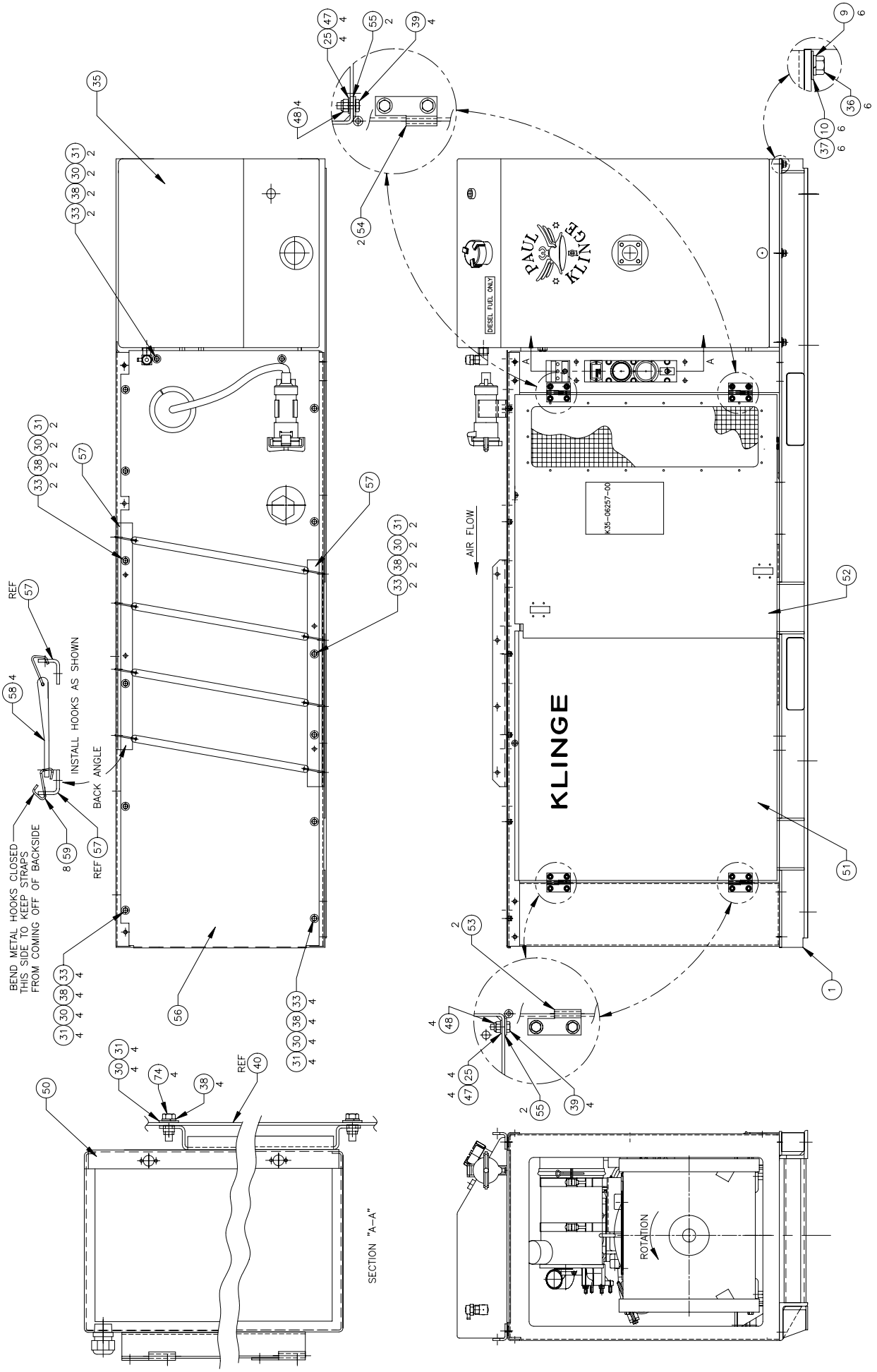


DETAIL "A"

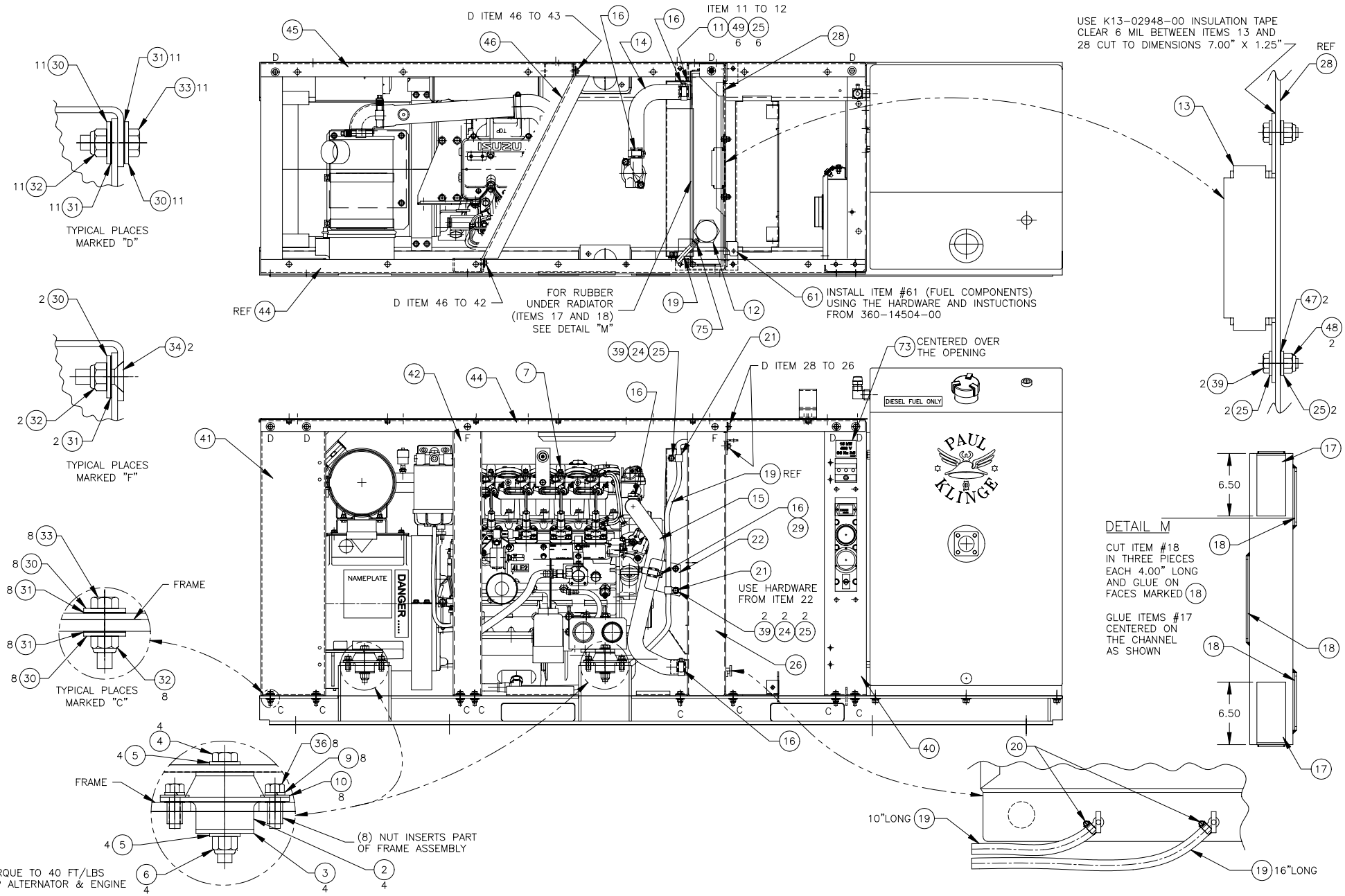
QTY	PART NO.	ITEM	DESCRIPTION
1	360-14361-12	1	FRAME ASSEMBLY NMG-115-12 COMPLETE
4	XB-999076	2	SHOCK MOUNT
4	XB-999077	3	WASHER SNUBBING
4	K21-16220-00	4	SCREW HEX SS 1/2-13 X 3.5
8	K21-16195-00	5	WASHER FLAT SS 1/2 1.06 O.D.
4	K21-14921-11	6	NUT LOCK SS 1/2-13
1	360-14355-01	7	ENGINE ALTERNATOR ASSEMBLY NMG-115-10 ISUZU / LIMA
		8	
14	K21-14069-00	9	WASHER LOCK SS 3/8 HEAVY 18-8
14	K21-14073-00	10	WASHER FLAT SS 3/8 0.44 I.D. 1.00 O.D. 0.083 THICK
1	360-14489-00	11	FAN SHROUD ASSEMBLY NMG-115-10
1	XB-340015	12	RADIATOR 4 ROW / 3 PASS
1	XB-205126	13	BRACKET ASSEMBLY RADIATOR HOLD-DOWN
1	XB-340024	14	HOSE RADIATOR INLET
1	XB-340025-01	15	HOSE RADIATOR OUTLET NMG-115-10
5	K21-18426-02	16	CLAMP HOSE SS HD RANGE 1.2" - 2.1"
2	XB-993011-03	17	RUBBER NEOPRENE 3/16 X 3 X 9"
1	XB-993000-05	18	RUBBER NEOPRENE 1/8 X 1 X 12"
66 IN.	XB-998090	19	TUBE PVC CLEAR 5/16 I.D.
2	K23-10280-00	20	CLAMP HOSE SS RANGE 0.38 - 0.63 5/16" WIDE
6	K21-15649-03	21	CLAMP CUSHIONED SS 1/2 I.D.
1	060-14473-00	22	HOLDER RADIATOR OUTLET HOSE
		23	
3	K21-10186-00	24	WASHER LOCK SPG SS 1/4 HEAVY 18-8
31	K21-10189-00	25	WASHER FLAT SS 1/4 0.63 O.D. 0.065 THK 18-8
1	060-14394-00	26	POST RADIATOR FRAME FRONT NMG-115-10
1	360-14529-00	27	POST ASSEMBLY RADIATOR FRAME REAR NMG-115-10
1	360-14398-00	28	ANGLE ASSEMBLY RADIATOR TOP SUPPORT NMG-115-10
1	060-15603-00	29	SLEEVING RUBBER - HALF SECTION
87	K21-14072-00	30	WASHER FLAT SS 5/16 0.38 I.D. 0.88 O.D. 0.083 THICK
84	K21-50492-04	31	WASHER INSULATING PVC 5/16 (0.88 O.D. X 0.020 THICK)
28	K21-14921-07	32	NUT LOCK SS 5/16-18
44	K21-14059-00	33	SCREW HEX SS 5/16-18 X 1.00"
2	K21-16395-04	34	SCREW FLAT SS 5/16-18 X 1.00" SLOT
1	360-14500-00	35	TANK ASSEMBLY FUEL NMG-115-10
14	K21-14972-00	36	SCREW HEX SS 3/8-16 X 1.25"
6	K21-50492-05	37	WASHER INSULATING PVC 3/8 (1.00 O.D. X 0.020 THICK)
29	K21-14761-00	38	WASHER LOCK SS 5/16 HEAVY 18-8
18	K21-14057-00	39	SCREW HEX SS 1/4-20 X 3/4"

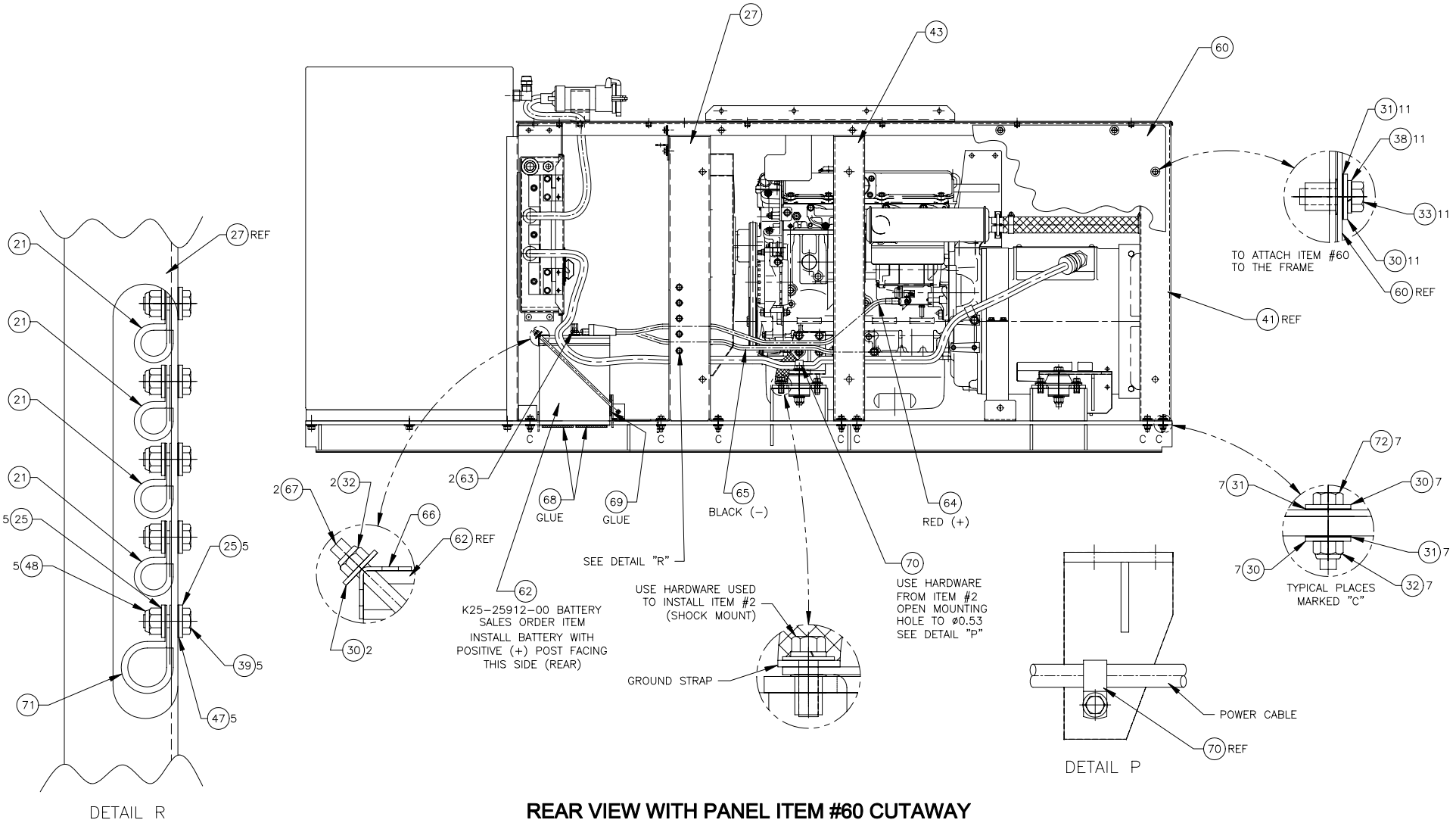
QTY	PART NO.	ITEM	DESCRIPTION
1	360-14363-00	40	PANEL ASSEMBLY TANK END NMG-115-10
1	360-14491-00	41	PANEL ALTERNATOR END WEDED & PAINTED WHITE NMG-115-10
1	060-14512-00	42	POST FRAME FRONT WELDED & PAINTED WHITE
1	360-14530-00	43	POST ASSEMBLY FRAME REAR NMG-115-10
1	360-14378-12	44	ANGLE ASSEMBLY TOP FRONT NMG-115-12
1	360-14376-00	45	ANGLE ASSEMBLY TOP REAR NMG-115-10
1	060-14482-00	46	ANGLE DIAGONAL SUPPORT TOP PLATE NMG-115-10
15	K21-50492-03	47	WASHER INSULATING PVC 1/4 (0.62 O.D. X 0.020 THICK)
15	K21-14921-05	48	NUT LOCK SS 1/4-20
6	K21-14642-00	49	SCREW HEX SS 1/4-20 X 1/2"
1	360-14374 00	50	BOX ASSEMBLY ELECTRICAL FULLY WIRED NMG-115-10
1	360-14475-00	51	DOOR ASSEMBLY LEFT - ALTERNATOR END NMG-115-10
1	360-14477-12	52	DOOR ASSEMBLY RIGHT - ENGINE END NMG-115-12
2	K29-17880-01	53	HINGE SLIP SS 9/32 HOLE SOCKET LEFT HAND
2	K29-17879-01	54	HINGE SLIP SS 9/32 HOLE SOCKET RIGHT HAND
4	060-09113-00	55	INSULATOR HINGE
1	360-14494-00	56	PANEL ASSEMBLY TOP NMG-115-10
2	060-14492-00	57	RETAINER POWER CABLE NMG-115-10
4	K28-10691-00	58	STRAP 15" LONG NO HOOKS
8	K29-18490-00	59	HOOK STRAP SS ø0.125 WIRE
1	360-14495-00	60	PANEL ASSEMBLY REAR NMG-115-10
1	360-14504-00	61	FUEL SYSTEM COMPONENTS NMG-115-10
1	K25-25912-00	62	BATTERY 12 VOLT 3/8-16 STUDS - 625 CCA
2	K25-25927-00	63	NUT BATTERY SEALING 3/8-16
1	360-14506-01	64	BATTERY CABLE POSITIVE (+) NMG-115-10
1	360-14506-02	65	BATTERY CABLE NEGATIVE (-) NMG-115-10
1	060-14493-00	66	ANGLE SS BATTERY HOLD-DOWN
2	XB-209049	67	ROD BATTERY HOLD-DOWN
2	XB-993011-02	68	RUBBER NEOPRENE 3/16 X 3 X 12"
1	XB-993011-22	69	RUBBER NEOPRENE 3/16 X 2 X 8.5"
1	XB-998077	70	CLAMP CABLE CS VINYL COATED 0.81 I.D. 0.406 MTG. HOLE
1	K21-15649-08	71	CLAMP CUSHIONED SS 3/4" I.D. 0.28 MTG. HOLE
7	K21-14730-00	72	SCREW HEX SS 5/16-18 X 1.25"
1	K35-06266-00	73	LABEL 15KW 480V 60HZ 3ø
4	K21-50225-25	74	SCREW HEX SS M8 X 1.25 X 25
1	K23-07799-00	75	CLAMP HOSE 7/16 OD 0.075 SS WIRE

NOTES:
1. FOR CLARITY NOT ALL DETAILS ARE SHOWN IN THE DIFFERENT VIEWS.
2. INSTALL ITEM #61 (FUEL SYSTEM COMPONENTS) USING THE HARDWARE AND INSTRUCTIONS FROM 360-14504-00.



FINAL ASSEMBLY
NMG-115-12


TYPICAL PLACES MARKED "D"
TYPICAL PLACES MARKED "F"
TYPICAL PLACES MARKED "C"
D ITEM 46 TO 43
ITEM 11 TO 12
D ITEM 46 TO 42
REF
FOR RUBBER UNDER RADIATOR (ITEMS 17 AND 18) SEE DETAIL "M"
INSTALL ITEM #61 (FUEL COMPONENTS) USING THE HARDWARE AND INSTUCTIONS FROM 360-14504-00
USE K13-02948-00 INSULATION TAPE CLEAR 6 MIL BETWEEN ITEMS 13 AND 28 CUT TO DIMENSIONS 7.00" X 1.25"
CENTERED OVER THE OPENING
D ITEM 28 TO 26
DIESEL FUEL ONLY
NAMEPLATE
DANGER.....
USE HARDWARE FROM ITEM 22
FRAME
(8) NUT INSERTS PART OF FRAME ASSEMBLY
TORQUE TO 40 FT/LBS TYP ALTERNATOR & ENGINE
DETAIL M
CUT ITEM #18 IN THREE PIECES EACH 4.00" LONG AND GLUE ON FACES MARKED 18
GLUE ITEMS #17 CENTERED ON THE CHANNEL AS SHOWN
6.50
6.50
10"LONG
16"LONG

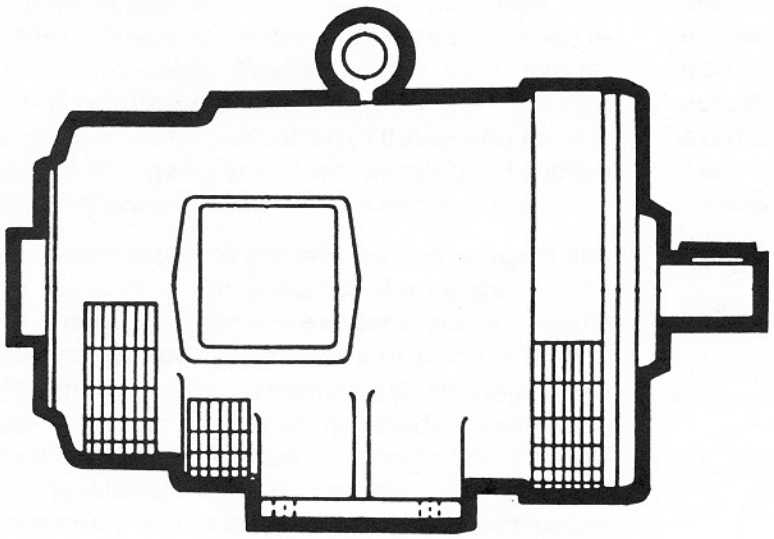


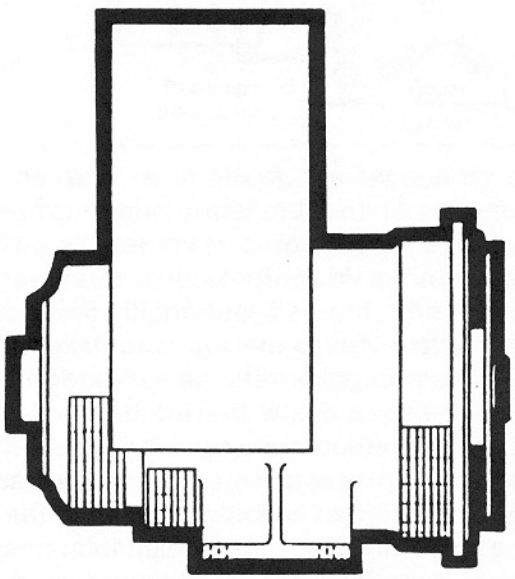
REAR VIEW WITH PANEL ITEM #60 CUTAWAY

MARATHON® ELECTRIC

INSTALLATION, OPERATION AND MAINTANENCE MANUAL

TYPE MAC Brushless AC Synchronous, Internally Regulated Alternator Frame 280





Marathon Electric Mfg., Corp.
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Making Energy Work For You

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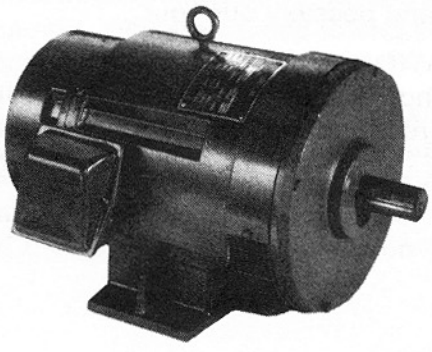
PRINCIPLE OF OPERATION

The MAC generator is a self-regulated, rotating field synchronous unit with the rotor having a salient pole construction with amortisseur windings. The generator stator and exciter stator are combined in a common housing. The generator field, exciter rotor and rotating rectifier assembly are mounted on a common shaft. The output of the exciter rotor is applied to the generator field winding through a rotating, full wave bridge, silicon rectifier unit.

The exciter pole pieces contain residual magnetism, setting up lines of force across the air gap to the exciter armature. When the exciter armature begins to rotate a voltage is induced and current flow is initiated in the exciter armature AC windings. This voltage is fed to the rotating rectifier assembly, rectified and fed to the alternator field coils. This DC voltage is sufficient to magnetize the laminated alternator field which will set up lines of force across the air gap to the alternator stator. As the generator rotor rotates a voltage will be induced and current will flow in the alternator stator windings and to the output circuit.

All connections between the exciter stator windings and the generator stator windings are internally connected within the stator housing. Only the output power leads of the generator unit are brought out to the generator terminal box.



CIRCUIT DIAGRAM

Figure 2 shows the internal schematic diagram of the generator, exciter and rectifier unit. The generator is a three phase unit and the exciter stator and exciter rotor also have three phase windings. A portion of the exciter stator windings is connected across a tap on the generator stator winding. This exciter shunt winding provides the generator field excitation power required for the generator no load voltage. Another portion of the exciter stator windings is connected in series with the output of the generator and provides a compounding excitation characteristic.

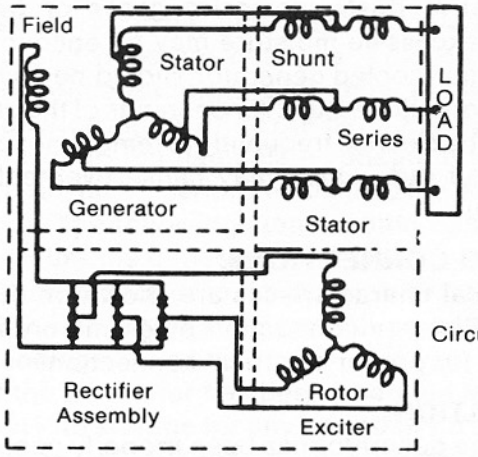


Figure 2 Circuit Diagram

The rotor is, in effect, the secondary of a rotating current transformer induction frequency converter. The exciter rotor output voltage is applied to the generator field windings by a three phase full wave rotating silicon rectifier unit. The response time of the excitation system is very fast since the exciter stator carries an alternating current corresponding to the load current which appears immediately on the exciter primary. An increase in load current will cause an immediate increase in the exciter secondary output voltage which is rectified and applied to the generator field windings. The inherent compounding charachteristics of the excitation system provide excellent voltage regulation even under heavy overload conditions.

PERFORMANCE DATA

The excitation characteristics of fast exciter response with maximum exciter output makes this generator ideal for motor starting loads that require a very high current at low power factor during the motor starting and acceleration periods. At the same time it offers the rugged, reliable, maintenance-free operation inherent in the brushless type generator. No external controls are needed with a Lima MAC generator.

The performance of a 10 kW Lima MAC synchronous generator is indicated in Figure 3.

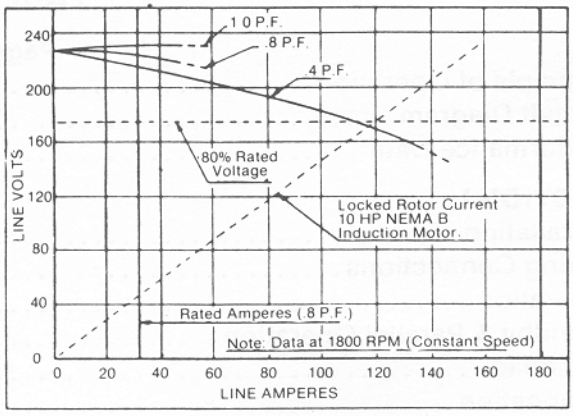


Figure 3

SECTION I
INSTALLATION AND OPERATION

UNPACKING:

When unpacking, check for damage in shipping. Report any damage at once to delivering carrier. Read instruction tags shipped with generator.

INSTALLATION:

The generator must be properly aligned and located in a well-ventilated place where the air temperature will not exceed 40°C or 104°F, and should be accessible for cleaning. An open type generator should not be located where there are abrasive or conductive dusts, corrosive gases or fumes, or where excessive moisture may be encountered. A totally fan-cooled generator should be used where these conditions exist. Air openings of the generator should be cleaned frequently to remove accumulated dust and dirt, which may cause overheating and burn out.

WIRING CONNECTIONS:

Electrical characteristics are shown on the nameplate. Refer to connection diagrams on pages 10 and 11 for proper electrical connections.

OPERATION:

After the generator has been properly connected to the driving unit and the load lines connected to the generator's leads according to the wiring diagram, the unit is ready for operation. To connect the coupling discs of a single bearing generator to the driving engine's flywheel it may be necessary to slide the rotor forward a few inches out of the stator, taking care not to slide it so far as to cause the rotor to come out of the bearing entirely and down upon the stator windings, causing damage to the windings. Ordinarily, a chain hoist is needed to jockey the generator rotor into position.

STANDBY UNITS:

Generators used as an auxiliary power source in case of commercial power failure must be isolated from the commercial line before being placed in operation.

CAUTION: MAKE SURE UNIT IS COMPLETELY SHUT DOWN AND FREE OF ANY POWER SOURCE BEFORE ATTEMPTING ANY REPAIR OR MAINTENANCE ON THE UNIT.

PARALLEL OPERATION:

For parallel operation, both units must be of the same voltage, frequency, and phase. Phase voltages of paralleled units must be synchronized. This generator set utilizes the "dark lamp" method of paralleling.

ROTATION:

The generator can be operated in either direction of rotation.

OVERLOAD:

The load on the generator should be checked with an AC ammeter to see that the ampere rating stamped on the nameplate is not exceeded. Prolonged overload on the generator may cause it to overheat and possibly burn out.

LUBRICATION:

Ball bearings on Lima generators are pre-lubricated and require no further lubrication for the life of the bearing.

SECTION II
SERVICE AND MAINTENANCE

PREVENTATIVE MAINTENANCE AND OPERATING PERCAUTIONS:

Costly repairs and down time can usually be prevented by operating electrical equipment under conditions which are compatible with those at which the equipment was designed to operate. Follow the instructions as outlined to insure maximum efficient utilization of the electrical equipment.

COOLING:

Keep all cooling parts clean and make certain sufficient room is left on all sides for a plentiful supply of fresh coolant air flow. DO NOT EXCEED AIR TEMPERATURE RISE AS SHOWN FOR 50°C ABOVE A 40°C AMBIENT. This insures that the insulation NEMA Class "F" will not be damaged. **DO NOT EXCEED RATED LOAD**, except as specified for the equipment. **OPERATE AT RATED SPEED.** Failure to operate generators at rated load or speed will cause overheating and possibly damage to windings due to over voltage or current.

BEARING REPLACEMENT:

Factor lubricated shielded bearings will normally provide several years of trouble free service when operated under normal conditions. Excessive bearing load and adverse environment conditions will greatly shorten bearing life. Should bearing failure occur, bearings can be replaced. **ALWAYS REPLACE WITH THE SAME TYPE BEARING AS INSTALLED AT THE FACTORY. CHECK PARTS LIST FOR PART NUMBER.** Include generator serial number when ordering bearings.

ROTATING DIODE BRIDGE:

The rotating diode bridge can be removed and replaced. Excessive overcurrent, overvoltage, overspeed, or reverse currents can cause damage to the assembly or any of the component parts.

ROTOR DAMAGE:

The damper bars of the generator prevent excessive hunting when AC generators are operated in parallel. Damper bars, because they must have a low electrical resistance and are subjected to extreme centrifugal forces, must be mechanically secure and permanent. Consequently, they are welded to end plates completely covering the field.

All rotors are static and dynamically balanced to a high degree on precision machines to assure minimum vibration. They will, therefore, remain dynamically stable at speed well beyond the synchronous speed of the generator. The rotors on generators are, however, subjected to extreme centrifugal forces which can increase beyond safe operating limits at excessive overspeed. Therefore, the prime mover should be adequately governed to prevent overspeed.

Damage to the rotor can also occur due to overheating which can be caused by the air flow being restricted from dust or other foreign objects collecting in the air passage.

If a rotor becomes defective, it should be returned to the factory with full nameplate data, because the rotor coils are enclosed in welded squirrel cage winding. To repair a rotor the special tooling and technique of the factory is necessary and essential. The Lima Electric Company, Incorporated, facilities can perform a complete rebuild, or rewind job with greater skill and craftsmanship than can be found in the average motor rewind shop. Should a failure occur, the factory should be notified immediately and steps will be taken to get the generator back into service with the least expense; and more important, to deterime the cause of the failure and take steps to prevent a recurrence.

PRECAUTIONS:
GENERATOR WINDINGS (DRYING):

Generators that have been in transit or storage for long periods may be subjected to extreme temperature and moisture changes. This can cause excessive condensation, and the generator windings should be thoroughly dried out before bringing the generator up to full nameplate voltage. If this precaution is not taken, serious damage to the generator can result. The following steps should be taken to effectively dry the generator windings:

A. (1) Place generator in drying oven or hot room.
   (2) Dry with warm air blower directed through windings.

B. (1) If the generator has been operated and then put into storage for any period of time, a P.D. George #11127 type air-dry fungus resistant varnish should be reapplied.

Experience has shown that it is necessary to take these precautions in locations such as seaboard installations and other highly humid areas. Some installations will be in atmospheres that are much more corrosive than others. A little precaution along the lines outlined here could eliminate an unnecessary repair job.

Each generator was subjected to a standard NEMA insulation test, which means 1000 volts plus twice the highest voltage for which the generator is rated was impressed between the winding and frame. All machines are insulated with a high safety factor for the class of insulation used. The latest and newest in insulation and baking techniques are used.

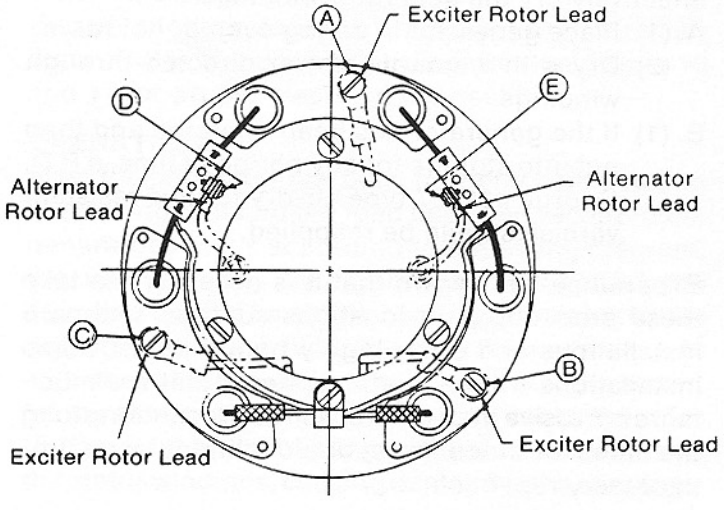
The finest insulation job can be very quickly broken down carelessly applying high voltage to windings in a moisture saturated condition. Mishandling in this respect can easily cause a breakdown, making it necessary to return the generator to the factory for repair, and consequent expense and loss of time.

WARNING: HIGH VOLTAGE (DIELECTRIC) TESTING MUST NOT BE PERFORMED TO THE MACHINE WITHOUT FIRST OBSERVING NEMA RULES. THE INSULATION OF THIS GENERATOR WINDING MAY BE SAFELY CHECKED BY USING A MEGGER. A HIGH MEGGER READING INDICATES LOW INSULATION LEAKAGE.

RESTORING RESIDUAL MAGNETISM:
The current necessary to magnetize the alternator field is obtained from the exciter. Initially, upon starting the generator, current flow and voltage are induced into the exciter armature by the magnetic lines of force set up by the residual magnetism of the exciter field poles.

Residual magnetism of the exciter field poles may be lost or weakened by a strong neutralizing magnetic field from any source, or if the generator is not operated for a long period of time.

Should the generator fail to build up voltage after being disassembled for any reason, a momentary short-circuit of any two generator leads should be sufficient to correct this condition. If not, an alternate method may be used. Apply either an alternating current or a direct current voltage of approximately 20 volts to any to generator leads. Do not make a positive connection but rather touch the leads together until the generator voltage begins to rise and then remove. It is suggested that a 30 ampere fuse be inserted in the circuit to prevent any damage in case the build-up voltage is not removed quickly enough.



Rectifier Assembly 778600
Figure 5

Start generator and observe generator build-up. Reflash field if generator output voltage does not build up.

TESTING DIODES WITH AN OHMMETER:
Isolate the rectifier assembly by disconnecting the two leads from the main rotor and three leads from the exciter rotor. Do no unsolder diodes. Test each diode by applying the probes of an ohmmeter to the anode and cathode.

A good diode will produce a meter reading of only a few ohms when the probes are applied in one direction, and a reading of near infinity when the probes are reversed. If both readings are high, or both are low, the diode is defective and must be replaced.

Diode failure after a 25 hour "run-in" period is generally traceable to external causes such as lightning strike, overheating or a reverse current fed into the alternator. To save excessive service time and call-backs, it is a generally accepted practice to replace the entire rectifier assembly where failure can be traced to external causes AFTER THE CAUSE OF DIODE FAILURE IS IDENTIFIED AND CORRECTED.

RECTIFIER REMOVAL PROCEDURE:
Rectifiers may be removed throught the bearing cap on the rear of the generator. (See Figure 6, Item B.) First, remove the bearing cap by removing the four bolts shown in Figure 6 as Item A. You can now see both the bearing (Item C) and rectifier assembly (Item D). Use a bearing puller to remove the bearing from the main shaft being careful to locate the puller on the inner race of the bearing to avoid bearing damage. Once the bearing is free it is then necessary to disconnect leads A, B, C and D as shown in Figure 5 assembly drawing. Then remove the three hold-down cap screws which secure the rectifier assembly to its adaptor. Once this procedure is complete the rectifier assembly is free for removal.

Follow the testing procedures outlined in testing diodes and Figure 5.

After the rectifier assembly has been repaired or replaced, reverse the procedure as stated above, being careful that all lead connections are tight and that set screws are locked with a Lock-Tite compound.

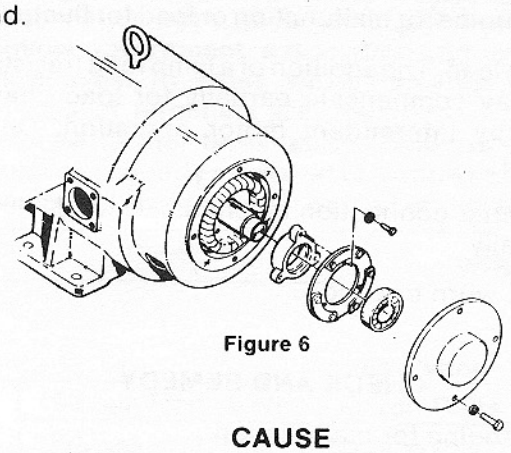


Figure 6

TROUBLESHOOTING PROCEDURES AC BRUSHLESS GENERATOR

As with any machine, trouble may develop in electrical generators. It may be due to long service or neglect of regular maintenance, servicing, and checking. Should trouble develop, the following instructions will be helpful in tracing the cause and making repairs.

SPEED DEVIATIONS:

The generator speed should be maintained at rated nameplate speed. The frequency and voltage of the generator output depends on speed. If the generator runs slower than rated speed, the voltage will drop off.

NO VOLTAGE:

CAUSE	CHECK AND REMEDY
Loss of residual magnetism in exciter field poles.	Flash field, see page 6 "Restoring Residual Magnetism."
Open in stator windings.	Check for continuity in windings. Return to factory for repair if open.
* Open or short in rotating rectifiers.	Check rectifiers per previous instructions, replace if faulty.
Short circuited.	Clear lead to restore voltage build-up.
* Open in alternator field.	Check for continuity and return rotor to factory for repair if field coils are open.
* Shorted exciter armature.	Check for short and replace if faulty. Use a "Kelvin" type bridge to measure this resistance.
* Shorted leads between exciter armature and generator field.	Test and repair.

NOTE: *Designate rotating parts. Generator must be open to test.

LOW VOLTAGE:

CAUSE	CHECK AND REMEDY
Excessive load.	Reduce load. With 3 phase generators, the load on each leg should be as evenly balanced as possible and should not exceed the rated current on any leg.
Low speed.	Check engine for malfunction or system for overload.
Line loss.	Increase size of line lead wire.
High resistance connections — connection will be warm or hot.	Make better connection electrically and mechanically.
Shorted field.	Test field coils for possible short by checking resistance with an ohmmeter or resistance bridge. Return rotor assembly to factory for repair if alternator field coils are shorted.
Low power factor.	Reduce inductive (motor) load. Some AC motors draw approximately the same current regardless of load. Do not use motors of larger horsepower rating than is necessary to carry the mechanical load.

FLUCTUATING VOLTAGE:

(May be indicated by flickering lights)

CAUSE	CHECK AND REMEDY
Irregular speed of engine.	Check engine for malfunction or load for fluctuation.
Fluctuating speed.	Stabilize load. The addition of a lamp load (resistance load) may compensate partially for load changes caused by intermittent motor operation. Do not overload.
Loose terminal or load connections.	Make better connection mechanically and electrically.
Defective bearing causing uneven air gap.	Replace worn bearing.

HIGH VOLTAGE:

CAUSE	CHECK AND REMEDY
Excessive speed.	Check engine for malfunction.

OVERHEATING:

CAUSE	CHECK AND REMEDY
Generator overloaded.	Reduce load. (Check with ammeter and compare with nameplate rating.)
Clogging ventilating screens.	Clean air passages.
High room temperature	Improve ventilation.
Insufficient circulation.	Provide cross-ventilation.
Low power factor.	Reduce inductive loads or install power factor improvement capacitors.
Unbalanced load.	The load on each leg should be as evenly balanced as possible and should not exceed the rated current on any leg.
Dry bearing.	Replace bearing.

MECHANICAL NOISE:

CAUSE	CHECK AND REMEDY
Defective bearing.	Replace bearing.
Rotor scrubbing on stator.	Bad bearing, replace. Bent shaft, return to factory. Loose endbell, tighten; loose drive discs, tighten.
Loose laminations.	Return to factor for repair.
Loose or misaligned coupling.	Tighten or align.

GENERATOR FRAME PRODUCES SHOCK WHEN TOUCHED:

CAUSE	CHECK AND REMEDY
Static charge.	Ground generator frame.
Grounded armature or field coil.	Return to factory for repair.

ELECTRICAL WIRING PROCEDURES — WIRING DIAGRAMS

CAUTION

Wiring of the alternator should be done in accordance with good electrical practices. Follow government, association and industry standards. In some wiring arrangements, groups of terminals are connected together with no further termination. These terminals must be properly insulated to avoid a hazard to personnel and potential equipment damage.

Lima MAC alternators are supplied in 10-lead or 12-lead configurations. From the nameplate information and system voltage requirements, select the appropriate wiring diagram from the information that follows.

WIRING REFERENCE CHART

	Configuration	MAC Type Specific Voltage (60 HZ)	Ref. Diag.
3 Phase	12-Lead Unit, 4-Wire 240 Volt Delta Connected	240V	A
3 Phase	12-Lead Unit, High Voltage Wye Connected	416V	B
3 Phase	12-Lead Unit, Low Voltage Wye Connected	208V	C
3 Phase	10-Lead Unit, High Voltage Wye Connected	480V	D
3 Phase	10-Lead Unit, Low Voltage Wye Connected	240V	E
1 Phase	12-Lead Unit, Low Voltage Delta	120V	F
1 Phase	12-Lead Unit, 240 Volt Zigzag	240V	G

DIAGRAM A
12-Lead Unit, 240 Volt, Delta Connected, 3 Phase

Connect together the following six sets of terminations:
T1 and T12 to form L1 — T2 and T10 to form L2
T3 and T11 to form L3 — T4 and T7 to form L0
T5 and T8 — T6 and T9

OUTPUTS:	120V, 1∅	240V, 3∅
	L1 to L0	L1 to L2
	L2 to L0	L2 to L3
		L1 to L3

CAUTION: Properly insulate all unused terminations.

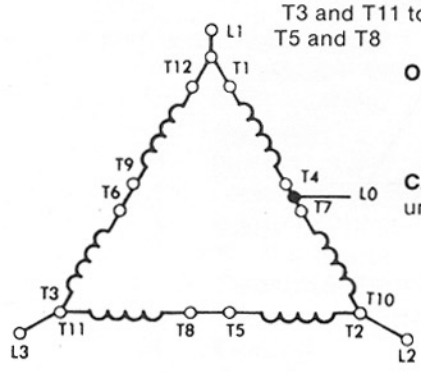


DIAGRAM B
12-Lead Unit, High Voltage, Wye Connected, 3 Phase

Connect together the following four sets of terminations:
T4 and T7 — T5 and T8 — T6 and T9
T10, T11 and T12 to form L0
T1 is L1 — T2 is L2 — T3 is L3

OUTPUTS:	240V, 1∅	416V, 3∅
	L1 to L0	L1 to L2
	L2 to L0	L2 to L3
	L3 to L0	L1 to L3

CAUTION: Properly insulate all unused terminations.

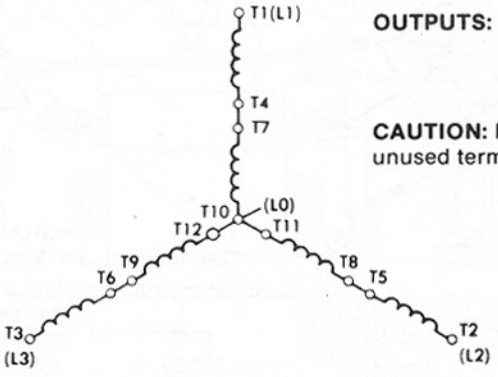
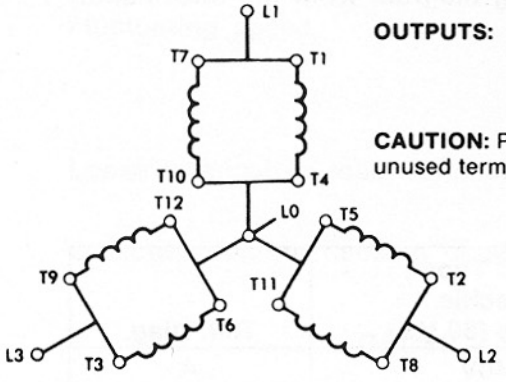


DIAGRAM C
12-Lead Unit, Low Voltage, Wye Connected, 3 Phase

Connect together the following four sets of terminations:
T1 dn T7 for form L1 T2 and T8 to form L2
T3 and T9 to form L3
T4, T5, T6, T10, T11 and T12 to form L0

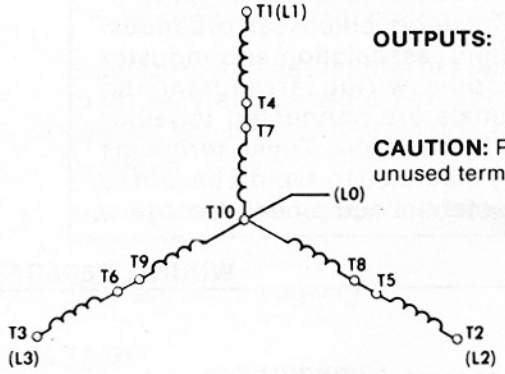


OUTPUTS:	120V, 1∅	208V, 3∅
	L1 to L0	L1 to L2
	L2 to L0	L2 to L3
	L3 to L0	L1 to L3

CAUTION: Properly insulate all unused terminations.

DIAGRAM D
10-Lead Unit, High Voltage, Wye Connected, 3 Phase

Connect together the following four sets of terminations:
T4 and T7 T5 and T8 T6 and T9
T1 is L1 T2 is L2 T3 is L3

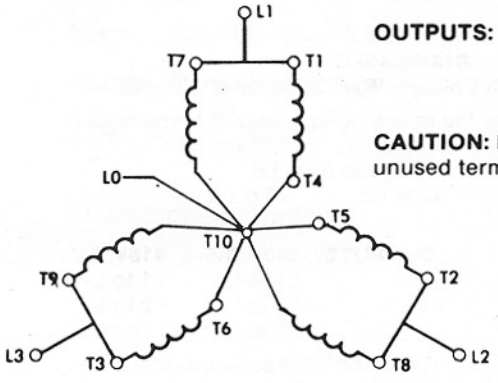


OUTPUTS:	277V, 1∅	480V, 3∅
	L1 to L0	L1 to L2
	L2 to L0	L2 to L3
	L3 to L0	L1 to L3

CAUTION: Properly insulate all unused terminations.

DIAGRAM E
10-Lead Unit, Low Voltage, Wye Connected, 3 Phase

Connect together the following four sets of terminations:
T1 and T7 to form L1 T2 and T8 to form L2
T3 and T9 to form L3
T4, T5, T6 and T10 to form L0

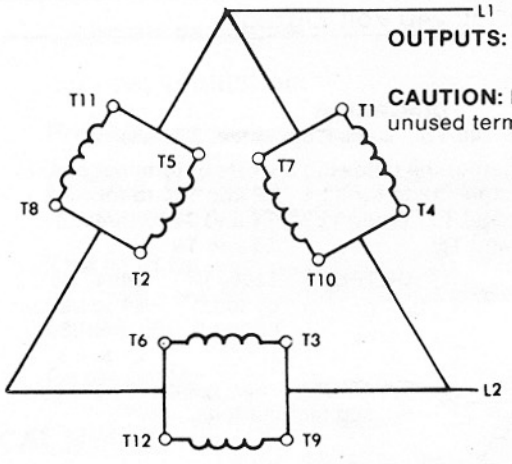


OUTPUTS:	139V, 1∅	240V, 3∅
	L1 to L0	L1 to L2
	L2 to L0	L2 to L3
	L3 to L0	L1 to L3

CAUTION: Properly insulate all unused terminations.

DIAGRAM F
12-Lead Unit, Low Voltage, Delta Connected, 1 Phase

Connect together the following three sets of terminations:
T2, T8, T6, T12 and Insulate
T1, T5, T7, T11 to form L1
T3, T4, T9, T10 to form L2

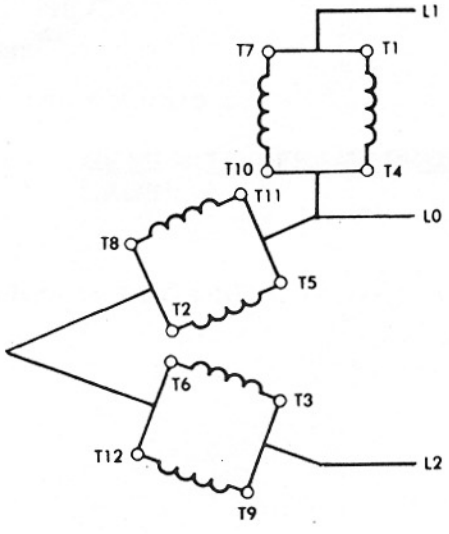


OUTPUTS: 120V, 1∅ L1 to L2

CAUTION: Properly insulate all unused terminations.

DIAGRAM G
12-Lead Unit, 240 Volt, Zigzag, 1 Phase

Connect together the following four sets of terminations:
T2, T8, T6, T12 and Insulate
T1, T7, to form L1
T3, T9, to form L2
T4, T10, T5, T11 to form L0



OUTPUTS:	120V, 1∅	240V, 1∅
	L1 to L0	L1 to L2
	L2 to L0	

CAUTION: Properly insulate all unused terminations.